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PASSENGER SAFETY AND CONVENIENCE SERVICES IN AUTOMATED GUIDEWAY TRANSIT

VOLUME II: GUIDEBOOK

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16. Abstract The objective of one segment of UMTA's Automated Guideway Transit Technology (AGTT) program, the Systems Safety and Passenger Security (SS&PS) study, is the development of guidelines for the assurance of actual and preceived passenger safety and security in Automated Guideway Transit (AGT) systems. Because AGT systems are essentially unmanned, the possibility exists that passenger problems may go undetected for long periods of time. In conventional transit operations, vehicle operators and station attendents have been assigned secondary roles connected with Passenger Safety and Convenience Services (PS&CS). Giving directions, offering assistance to the ill, the handicapped, or the confused, and providing first aid to the injured, are among the service routinely provided. These same services must be provided on AGT in order to establish passenger acceptance of an unmanned environment and to ensure their safety, comfort, and well being.

To achieve this goal, current practices have been reviewed, analyzed, and evaluated for their effectiveness in accomodating PS&CS problems in AGT. These practices for providing PS&CS in both conventional and AGT have been assessed as applicable to highly automated transit systems. These guidelines have been developed suggesting methods and procedures to provide these services for AGT systems.

The final objective of this guidebook is to provide the most effective methods and procedures for ensuring passenger safety and convenience services in AGT systems. Its contents provide guidance for AGT system planners, designers, operators, and evaluators in identifying potential problems and assessing proposed methods and procedures.

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AGT; Automated Guideway Transit; Guidelines; Human Factors; Passenger Convenience Services; Passenger Safety; Safety and Security; Safety Program Plan

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16. Abstract

In conventional transit operations, vehicle operators and station attendants have been assigned secondary roles connected with passenger safety and convenience services. Giving directions, offering personal assistance to the ill, the handicapped or the confused and even providing first aid to the injured are among the services routinely provided. These same services must be provided on AGT in order to establish passenger acceptance of an unmanned environment and to ensure their safety, comfort and well being.

To achieve this goal, current practices have been reviewed, analyzed and evaluated for their effectiveness in accommodating passenger safety and convenience service problems in AGT. The final objective of this guidebook is to provide the most effective methods and procedures for providing safety and convenience services in the unmanned environment of AGT systems.

Background data for this guidebook is included in Volume I, published as Report No. UMTA-MA-06-0048-79-4.

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PREFACE

The U.S. Department of Transportation's Urban Mass Transportation Administration (UMTA), in order to examine specific Automated Guideway Transit (AGT) developments and concepts, has undertaken a new program of studies and technology investigations called the Automated Guideway Transit Technology (AGTT) program.

The objective of one segment of the AGTT program, the Systems Safety and Passenger Security Study (SS&PS), is the development of guidelines for the assurance of actual and perceived passenger safety and security in AGT systems. This work has been contracted, through the Transportation Systems Center (TSC), to a team composed of Dunlap and Associates, Inc., the University of Virginia, and the Vought Corporation.

The Systems Safety and Passenger Security (SS&PS) study has involved six related but separate tasks. Three were concerned with the development of guidebooks dealing with 1) passenger security, 2) evacuation and rescue, and 3) passenger safety and convenience services. A fourth task required the development of a passenger value structure model; a fifth involved research on the retention of seated passengers during emergency stops; and a sixth involved the conduct of a joint Government and Industry workshop to review and revise the three guidebooks.

The Passenger Safety and Convenience Services task has as its objective the production of a guidebook detailing the most effective methods and procedures for providing passenger safety and convenience services in AGT systems.

The author wishes to acknowledge the time and cooperation received while visiting various transit properties in the U.S. and Canada. Without the cooperation of transit officials and other experts, completion of this task would have been impossible. The author also wishes to thank the UMTA and TSC technical personnel for their assistance in the performance and documentation of this work, and in particular Duncan MacKinnon and Robert Hoyler, program manager and monitor respectively for UMTA, and Donald Sussman, project monitor for TSC, and his professional associates, Janis Stoklosa and Walter Hawkins.

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

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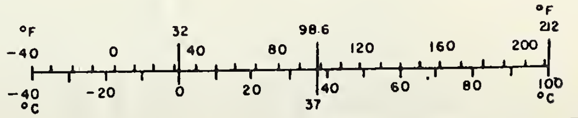
*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures. Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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EXECUTIVE SUMMARY

This report documents the results of a study conducted to produce a guidebook detailing methods and procedures for detecting and resolving the occurrence of Passenger Safety and Convenience Service (PS&CS) problems for Automated Guideway Transit (AGT). These methods and procedures are needed in providing aid or special assistance to the lost or confused, the ill or injured or the elderly and handicapped passenger. In other cases, they are associated with system related malfunctions such as inoperative fare equipment, graphics and doors. The methods and procedures also address passenger needs associated with abnormal weather, large crowds, fire/smoke and other related transit emergencies.

In conventional transit, station attendants and vehicle operators are available to detect and resolve special passenger problems. In the unmanned AGT environment, routine passenger services are typically provided through automation. However, when equipment or passenger failures occur or other abnormal events interrupt these automated services, it is important that these situations are detected and resolved in a timely manner. To establish passenger acceptance of unmanned systems and to insure their safety, recommended methods and procedures have been generated to accommodate these abnormal occurrences.

In performing this task, currently used methods and procedures for both conventional and AGT were compiled through interviews with transit officials and by review of available literature. The resulting data were systematically screened, analyzed and assessed for their effectiveness in accommodating potential passenger problems in future AGT systems. The resulting recommended methods and procedures for accommodating Passenger Safety and Convenience Service (PS&CS) in AGT are provided in Chapter 5 of Volume II. These methods and procedures address means of detecting and reporting as well as responses to thirteen different types of passenger problem occurrences.

Each problem area discussed was analyzed with respect to four basic detection methods (CCTV, sensors, passengers and AGT personnel) to determine which one or combination was most effective for detecting specific problems. Likewise, four basic response methods (voice communications, dispatching AGT personnel, remote control and altering system operations) were assessed for the most effective response to specific problem occurrences. Negative implications and cost considerations associated with each recommended method and procedure have also been identified. Where applicable, new and untried methods have been addressed.

CHAPTER 1. INTRODUCTION

Automated Guideway Transit (AGT) is a class of transportation in which unmanned vehicles are operated on fixed guideways along an exclusive right-of-way. The descriptive characteristics of AGT vary considerably between systems: vehicle capacities can range from one or two to more than 100 passengers; speeds range from slightly faster than walking to in excess of 50 miles per hour; and guideways range from wide, roadway-like configurations to narrow concrete or steel beams.

The technological building blocks of AGT are numerous and at various stages of developmental maturity. For example, some AGT systems employ mature railroad control technologies which date back to the late 1800's while other systems utilize the latest in aerospace technology. Most systems rely on conventional, wheeled support under the vehicle, yet others have demonstrated the feasibility of air cushions and magnetic levitation. No matter what technologies are involved, combining the technologies into a system design which can provide the traveling public with safe and dependable service is a complex process containing many problem areas. To address these problems, the Federal government has established the Automated Guideway Transit Technology (AGTT) Program. The principle purpose of the AGTT program is to provide information in the form of service and performance characteristics, specifications and guidelines for use by system planners, designers and Federal and local government agencies. In formulating the AGTT program, five major projects were identified:

- System Operations Studies
- Vehicle Longitudinal Control and Reliability Studies
- Vehicle Lateral Control and Switching Studies
- System Safety and Passenger Security Studies
- Guideway and Station Technology Studies

This Guidebook is a portion of the System Safety and Passenger Security Program and addresses Passenger Safety and Convenience Services.

A. Description of Passenger Safety and Convenience Services

There are a variety of passenger safety and convenience services provided in all major transportation systems. These services may include:

accommodations for the handicapped and the elderly; first aid; provisions for severe weather conditions; fire and smoke detection and signalling.

Occurrences of heart attacks, fainting, seizures, and falling down station stairs are not infrequent in transit systems. Transit personnel commonly provide first aid treatment and/or call for medical aid for sick or injured passengers. Transportation personnel also provide many non-medical services for passengers. Among the types of services the personnel provide are: giving directions; helping lost childern; calling for security guards or the police; announcing that a train will be delayed; removing animals that may have strayed onto the system; helping passengers from a disabled vehicle; reassuring passengers during emergencies.

These services may be very difficult to provide in a highly automated transportation system where few or no personnel are present in vehicles and at the stations. Methods and procedures must be identified to insure that a sick or injured passenger does not remain unattended in the system for hours; passengers in a disabled vehicle do not panic; and lost or confused passengers do not go unaided. Other passengers cannot be relied on to provide these passenger services. Some stations in off-peak hours may not be frequented for extended periods. Passengers may be at a loss as to exactly what to do in emergency situations. Well-intentioned passengers may give other passengers the wrong instructions because they are unfamiliar with the system. Passengers often will not be sufficiently authoritative to reassure and to calm other passengers.

1. Objective and Scope

a. Objective

The major objective of this task was to produce a guidebook detailing the most effective methods and procedures for ensuring passenger safety and convenience services for AGT systems. Its contents provide guidance for AGT system planners, designers, operators, and evaluators in identifying potential problems and assessing proposed methods and procedures.

It should be noted that the primary intent of this document is to provide guidance associated with abnormal occurrences that have an impact on routine passenger services or safety. These abnormal occurrences may result from people or equipment related failures or may be associated with the presence of large crowds, severe weather, or fires and related emergencies. The intent is not to provide specific guidelines for handling routine passenger services and safety measures. It has been assumed that the normal equipment, facilities and operating procedures that provide these routine services are adequate. It has been further assumed that vehicles and stations are not routinely manned.

b. Scope

Current practices for providing passenger safety and convenience services in both conventional and AGT have been assessed as applicable to highly automated transit systems. Guidelines have been developed suggesting methods and procedures to provide these services for AGT systems.

This effort has been based upon the following:

- Data collection involving literature review and personal interviews to define current practices for providing passenger safety and convenience services.
- Development of scenarios depicting realistic AGT problems.
- Selection of candidate methods and procedures for AGT problem resolution. New and untried methods have also been identified.
- Evaluation of candidate methods and procedures.
- Preparation of a final guidebook containing recommended methods and procedures.

As a prime part of this task, methods have been developed and assessed that offer solutions to:

- Detection and reporting of passenger safety and service needs.
- Response to accommodate detected passenger needs.

CHAPTER 2. GENERAL DESCRIPTION OF AGT

A. Introduction

Automated Guideway Transit (AGT) represents a concept aimed at providing more service per unit of labor than taxis, buses or conventional rapid transit. The thrust of automation in AGT systems is directed not only at the development of driverless vehicles, but also towards the substitution of automatic ticketing and fare collection systems for station personnel.

Along with their primary roles as drivers, onboard attendants and ticket sellers, conventional transit personnel have been assigned secondary roles connected with passenger safety and convenience service (PS&CS). The presence of these trained personnel on or about conventional transit systems has represented the key interface in handling passenger problems. This interface must still effectively exist for future AGT systems in order to establish passenger acceptance of unmanned systems and ensure their safety.

To accomplish this goal in AGT, the role of "central control" must be enhanced through the use of specialized equipment, and detailed methods and procedures. Specialized equipment is required so that central control personnel can be continuously aware of overall system status and passenger safety and convenience service (PS&CS) needs. Detailed methods and procedures are required so that central control personnel can be trained to respond to safety and convenience services problems quickly and effectively and without further compounding the problem.

This section is intended to create a general awareness of conventional and AGT differences, and addresses the following areas:

- General conventional transit areas requiring improvements for AGT systems
- Passenger safety and convenience service equipment requirements for AGT
- General operational considerations for AGT.

B. General Conventional Transit Areas Requiring Improvement for AGT Systems

In conventional transit, station and vehicle personnel have been the primary focal point for detecting and resolving most passenger related problems. In AGT, central control becomes the dominant overseer.

In order for central control to assume the functions of on-site personnel, a number of system changes and improvements are required.

The following are but a few improvements which are necessary to ensure a smooth transition from a conventional transit operation, dependent upon on-site personnel for passenger safety and convenience services, to an AGT system dependent upon central control to provide these same passenger services:

- Improved instructional information for using the system and passenger related equipment.
- Improved directional and destination information for stations and vehicles.
- Improved ease and simplicity of operation of passenger related equipment.
- Increased reliability of equipment.
- Use of more malfunction and status sensors for equipment with indications at central control.
- More CCTV coverage.
- Provisions for remote control functions operated from central control.
- More extensive and accessible means of communication between central control and passengers.
- Use of fail-safe design features/equipment where passenger safety may be jeopardized and fail-operational features/equipment where passenger convenience is concerned.
- Provisions for passengers to resolve their own problems through alternate means, backup methods, or use of supplementary equipment.
- Increased maintenance force due to increased system complexity and lack of station/vehicle attendants to resolve minor problems.

Some of the above areas are necessary for preventing the occurrence of passenger related problems, whereas others are required to detect and correct problem occurrences. Many of the above areas will be discussed in greater detail through the guidebook.

C. Passenger Safety and Convenience Services Equipment Requirements for AGT

In addition to the general areas of system improvement and change listed above, some specific items of equipment are required as part of any AGT system. This equipment is necessary because of the unmanned nature of AGT, which causes station and vehicle related equipment needs to differ from conventional transit when addressing passenger safety and convenience service problems.

Provided below is a list of equipment that has been identified as an absolute must when accommodating passenger safety and convenience service problems in AGT. This is a minimum equipment list and in no way is it meant to be all inclusive. In future discussions, when equipment needs are stated for implementing various recommended methods and procedures (Chapter 5), the equipment listed is assumed to be available. Only unique equipment needs beyond the above list will be stated.

- CCTV in all stations providing coverage as specified, by each recommended method and procedure discussed in Chapter 5.
- Two-way radio voice communication between all vehicles and central control. Communication requests originating from any vehicle shall automatically provide central control with an indication/readout which identifies the vehicle and its location.
- Two-way telephone communication between all stations and central control. Drop-line courtesy telephone requiring no dialing are preferred and should be accessible from either side of turnstiles. Incoming calls from stations shall automatically identify, to central control, the station from which it originated.
- One-way voice communication (P. A.)* from central control to "any selected" or "all" vehicles and stations.
- Two-way voice communications between central control and all pertinent AGT personnel such as maintenance, security, and supervisory personnel. In addition, means of communicating with other local service personnel (medical, fire, etc.) who may be called upon during certain emergencies, but are not full time AGT personnel. Portable "handie talkies" are required for "roving" personnel and droplines for fixed position personnel are desirable.

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*For some applications two-way P. A. systems may be worthy of consideration, but are not recommended as a part of the minimal equipment requirements.

There are, of course, numerous other equipment needs or command features which are required in AGT. These include a variety of sensors to denote malfunctions or abnormal occurrences associated with vehicle, station and systems related equipment. Also needed are a multitude of remote control features or commands that can be activated from central control. These include control features for vehicles, guideway switches, guideway power, etc. These are typically more system oriented and have not been defined as standard equipment for passenger safety and convenience services, but may influence it indirectly.

D. General AGT Operational Considerations

Like the design and equipment differences which have been discussed, there are also different operational philosophies that exist for conventional transit versus AGT systems.

Operationally, in an AGT environment, central control becomes the focal point for all problems including passenger safety and convenience problems. To detect problem occurrences, central control personnel have to rely upon special sensors, CCTV, AGT personnel, and in some cases passengers. Special sensors (status/malfunctions) on passenger related equipment (turnstiles, fare equipment, doors, graphics, elevators, escalators, etc.) become increasingly important since they afford a fast and reliable means to detect equipment related problems. Detection of non equipment-related problems requires the use of CCTV, and roving AGT personnel and passenger inputs via vehicle and station communications.

Details related to actual detection and response methods and procedures for specific passenger safety and convenience service problems are provided in Section V and will not be discussed here. However, there are some general operational considerations that will be touched upon. These general considerations have proven beneficial in current AGT applications and help to ensure safer operation, minimize delays, reduce manning requirements, and directly or indirectly enhance passenger safety and convenience services. Some of the considerations summarized here will be alluded to later as part of various recommended methods and procedures but may not be discussed in detail.

The following presents an assortment of miscellaneous and general considerations which will enhance passenger safety and service. Their applications are numerous. For details related to specific problem occurrences, see Chapter 5.

- Every effort should be made to resolve non-hazardous problems from central control via radio, telephone, or PA or by remote control capabilities, rather than dispatching AGT personnel.

- For potentially hazardous occurrences or situations where prolonged service delays are anticipated, or where definite maintenance or corrective action is required, dispatch appropriate AGT personnel to ensure safety of passengers and prevent chain reaction of events which may lead to termination of service.

- The use of standard and easily identified uniforms for all AGT personnel who frequent the system is highly desirable to aid passengers in seeking assistance and to provide reassurance during response procedures.

- In some situations, detection and reporting of problem occurrences has been enhanced by use of airline, newsstand, novelty shop, or other personnel that are closely associated with a transit operation. This concept has worked well in airports and should apply to other AGT environments if efforts are made to encourage their participation. Such participation would probably be used mainly for problems associated with lost children, reporting acts of crime and vandalism or aiding the lost or confused passenger.

- During service delays/interruptions, keep passengers informed. Vehicle PA reassurance announcements for passengers stranded onboard vehicles in queues are of extreme importance. These announcements help prevent uncontrolled passenger evacuations and also reduces radio and telephone inquiries to central control.*

- Central control should acknowledge and verbally respond to each "request for communications" that originates from onboard vehicles. If no verbal response is received from a vehicle requesting communication, central control should observe that vehicle via CCTV at the next station and/or dispatch AGT personnel to investigate the circumstances surrounding the non-response.

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*The use of pre-recorded messages may be worthy of consideration to handle some of the required communications.

- For problems that impact vehicle movement, with the threat of multi-car queues developing, consider the following:
  - Rerouting of other vehicles away from the problem area when possible. Even if travel times and distances are increased, passengers on moving vehicles grow far less impatient than passengers on stopped vehicles; thus, the potential for uncontrolled vehicle evacuations is reduced.
  - Hold vehicles in stations (with doors open) that are upstream from a problem site to prevent long queues at problem area. Impatient vehicle passengers at station stops may deboard vehicles safely rather than making unsafe evacuations in between stations.
- If the need arises to evacuate vehicles, make every attempt to get the affected vehicles to stations to deboard passengers in the safe confines of a station. This may require "manual vehicle operations ", use of tugs or pushing one vehicle with another. Removing people from vehicles stranded in the guideway between stations is not desirable and should be avoided if possible. Smoke or fire onboard a vehicle is, of course, an obvious exception.
- Determine need for AGT operational personnel fluent in the foreign languages that are common in the local area or among potential users. If a bi- or multi-lingual capability is needed, consider the scheduling problems when meeting these requirements.

CHAPTER 3. STATEMENT OF SPECIFIC PASSENGER SAFETY AND CONVENIENCE SERVICE PROBLEMS

A. Problem Categories/Types

This section identifies and addresses fourteen major problem areas which are pertinent to passenger safety and convenience services in AGT. A listing of these problem areas is provided in Table 3-1. The objective of this guidebook is to provide guidance, primarily in the form of recommended method and procedures, for accommodating (detecting and resolving) the occurrence of these problems.

B. Factors (Situation Variables) Affecting Problems

With the occurrence of any passenger-related problem, there are a variety of situations or circumstances which may compound or influence that problem. These variables may categorically fall into any of the following areas:

Factors which influence:

- The actual occurrence of a problem
- The effects of a problem once it has occurred
- The detection of a problem
- The response to correct a problem

In this guidebook, primary emphasis has been placed on situation variables that influence detection and response to a problem.

Table 3-2 provides a summary of identified situation variables and summarizes the general effect or influence they have upon detecting and responding to various passenger safety and service problems. It illustrates how such things as problem occurrence locations, system location, system size, crowd size, weather, passenger condition, etc., may influence the actual detection of problems and also may compound problem resolution.

These situation variables were instrumental in generating representative scenarios for each problem type and also received further consideration throughout the process of deriving the recommended methods and procedures. Their importance should not be overlooked, so they have been included to create a further awareness, to the user of this document, of the many variables that influence the accommodation of various problem occurrences.

TABLE 3-1. IDENTIFIED PROBLEM AREAS RELATED TO PASSENGER SAFETY AND CONVENIENCE SERVICES IN AGT*

Personal Problem Areas:

1. Medical/first aid provisions for ill or injured
2. Aid to lost and confused
3. Aid to the illiterate
4. Aid in recovering lost or strayed children
5. Aid in recovering lost articles
6. Aid to elderly and handicapped (E&H)

System Problem Areas Affecting Passengers:

7. Inoperative graphics
8. Inoperative equipment (turnstiles, fare equipment, doors, etc.)
9. Soiled vehicles and stations
10. Animals or foreign objects in system (guideway)
11. Accommodation of large crowds
12. Provisions for abnormal weather
13. Fire/smoke detection
14. Passenger reassurance during delays and emergencies

*Problems related to passenger security (assault, robbery, etc.) and evacuation and rescue are areas which may typically be included in this listing. In this case, they have not been included because they have been addressed in another segment of the System Safety and Passenger Security Study. For information related to these topics, reference is made to Task I, "Passenger Security" and Task II, "Evacuation and Rescue" of the SS&PS study, which are covered in Report Nos. UMTA-MA-16-0048-79-7 and -2, -3, respectively.

TABLE 3-2. FACTORS AFFECTING DETECTION/RESPONSE TO PS&CS PROBLEMS

SITUATION VARIABLES	POSSIBLE EFFECTS
(1) Location of Problem o On vehicle - in station - moving - between station & stop	o Problem detection onboard vehicles is more difficult because of lack of CCTV coverage and lack of applications for sensors. o Response time for dispatched AGT personnel may be compounded because of access to vehicle location.
o In station - open or closed station - open or protected platform - at, above or below grade	o Open stations or platforms are typically more hazardous than closed stations and may require more systematic monitoring. o Access to stations above or below grade are typically more difficult and may compound response methods.
o In guideway - at, above or below grade	o Guideway above and below grade (underground) may reduce the occurrence of some problems (i.e., foreign object control) but may compound response access to problems.
(2) Location of System o campus o airport o downtown o amusement park o others	o Faster detection and response times for airport and downtown locations may be necessary because of pressing time constraints of passengers. Access to problems may be complicated by surrounding congestion.
(3) Surrounding Geography on Terrain o virtually inaccessible (over water) o accessible by land on - improved or unimproved road - congested or uncongested areas	o Response time for dispatched AGT personnel could be greatly increased by terrain or congestion of adjacent roadways.

TABLE 3-2. FACTORS AFFECTING DETECTION/RESPONSE TO PS&CS PROBLEMS (CONTINUED)

(4) Systems Accessibility . highly controlled (airports) . moderately controlled (campus) . nearly uncontrolled (D PM)	. Airports typically have controlled access and tight security; therefore, acts of vandalism or crime are minimal. In a DPM environment where access to the system may be unlimited, crime and vandalism may be a significant problem.
(5) System Size/Complexity . number of - stations - vehicles - miles of guideway	. Larger, more complex GRT systems with many vehicles, stations & miles of guideway will increase the potential for problem occurrence. . Detection, search and response efforts are generally more complex and time consuming for larger systems.
(6) System Conditions . crowded . moderate crowd . virtually empty	. A crowded system may compound the detection process via CCTV, may increase the probability of passengers reporting problems, may cause minor problems to snowball, may increase work demands of central control & AGT personnel; therefore, some minor problems may go undetected & unsolved. . For a virtually empty station, the reverse is essentially true.
(7) Weather . rain/flooding . snow/ice . high winds . heat	. Adverse weather may increase problem occurrences associated with falls/injuries, soiled vehicles & stations, etc. and, in general, will slow system operations. Detection & response times need to be faster during adverse weather; but, in reality, response times by dispatched AGT personnel are usually slower. Station entries and open station or platforms are of major concern.

TABLE 3-2. FACTORS AFFECTING DETECTION/RESPONSE TO PS&CS PROBLEMS (CONTINUED)

(8) Ambient Light . sunlight . darkness	. Darkness may compound detection & response to problems outside lighted station areas or vehicles.
(9) Passenger Types . first-time user . repeat user . mix of both	. Some systems may be used predominately by first-time users, hence the occurrence of problems may increase & passengers may need greater assistance for even minor problems. Repeat users may resolve, or seek alternate solutions to, their problems.
(10) Passenger Time Constraints . leisure . normal . critical	. Passenger time constraints in an airport environment are more critical than other environments, hence faster detection and response time is required. Amusement park applications are probably the other extreme.
(11) Passenger Condition . physical state or limitations - non or semi-ambulatory - sight limited - hearing limited - coordination limited - aging . mental state or cognitive limitations - conscious or unconscious - anxiety - illiterate	. Physical and mental limitations of passengers may increase the occurrence of many problems and can compound or prevent the reporting of occurrences. They may also increase the need to dispatch AGT personnel to resolve simple problems that might otherwise be solved by communication means.

TABLE 3-2. FACTORS AFFECTING DETECTION/RESPONSE TO PS&CS PROBLEMS (CONTINUED)

(12) Central Control Workload . heavy . moderate . light	Excessive workload resulting from "system demands" may reduce the probability of detecting and responding to less serious passenger-related problems.
(13) Guideway (G/W) Considerations . types - suspended overhead - monorail/rail rider - closed channel - channel with open floor	. Guideway types may increase or decrease probability of some problems--suspended, monorail & open channel type will decrease occurrence of foreign objects in guideway, prevent or discourage uncontrolled vehicle evacuations, but will compound access to vehicle related problems. . Closed channel types will present a reverse of the above.
. guideway usability for ingress/egress* - safe with power on (Tampa - G/W has adjacent walkway) - safe without power (AIRTRANS - G/W has flat floor and side walls) - unsafe (Seattle Monorail - G/W is narrow beam) - impossible (Roosevelt Island - vehicles are suspended from cables)	. Response times will increase to vehicle problem occurrences with unsafe or non-walkable guideways. . Safe walkable guideways will increase uncontrolled vehicle evacuations.
. guideway protection - enclosed (tunnel) - covered (roof/buildings) - exposed but fenced	. Enclosed or protected G/W will reduce occurrence of foreign objects in G/W and impact of adverse weather, etc., but will compound access to vehicle, complicate fire fighting and evacuation/rescue or other related emergencies.
. power rail protection - exposed . vertical mounting . horizontal mounting - covered	. Exposed power rails present a greater hazard to dispatched AGT personnel or uncontrolled passenger evacuations & may result in power outages due to foreign objects being thrown or blown into the G/W.

*Denote ability to use the guideway as a walking surface, e.g., ability for AGT personnel to use the guideway for access to a stranded vehicle or for passengers to use the guideway as a walkway during emergency egres

CHAPTER 4. BASIC METHODS AND PROCEDURES FOR ACCOMMODATING PROBLEMS*

A. Basic Method and Procedure Categories

When developing methods and procedures for accommodating passenger safety and convenience service (PS&CS) problems, it is desirable to address each problem in two separate steps:

- Methods and procedures used to detect and report problems
- Methods and procedures used to respond to problems

1. Basic Detection and Reporting Methods

PS&CS problems in an AGT environment can be detected and reported by any one or combination of the following basic methods:

- CCTV
- Special sensors
- AGT personnel
- Passengers

These basic detection methods differ little from those currently being used in conventional transit. However, there is a distinct shift in the emphasis for each method when applied to AGT systems. Transit personnel (station attendants and vehicle operators) and passengers are key detection sources in conventional transit. In AGT, the emphasis shifts to the use of CCTV and special sensors which are monitored at central control.

2. Basic Response Methods

Like the detection and reporting methods, there are also four basic response methods, or combinations thereof, that can be used to resolve various PS&CS problems. They include:

- Providing instructions directly to the affected passenger(s) via telephone, radio or P.A.

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*This chapter provides general background information related to detecting and accommodating PS&CS problems in AGT. Extensive details have been deliberately avoided. The intent is to create a general awareness of fundamental principles associated with problem resolution in order to better appreciate the recommended methods and procedures provided in Chapter 5. Of course, the real solution to any problem is to attempt to eliminate it before it occurs.

- Dispatching AGT personnel to problem site to correct the problem (security, maintenance, medical, supervision, or fire personnel).

- Exercising remote control features from central control that are directly related to passenger interface equipment (free wheel or lock turnstiles, commands to open, close or recycle station and vehicle boarding doors, unlock wheelchair gates, allow access to elevators, etc.)

- Altering system operations which affect a large portion of the system or passengers (reroute vehicles, alter vehicle speeds, remove power to guideway, initiate switch overrides, bypass stations, etc.).

Although the above methods are rather broad in nature, they serve as a basis for determining general applicability to various problems. There are, of course, many variations that can occur within the framework of each method that alters its applicability to each specific problem. In addition, various combinations of each of these four basic methods can also be used in accommodating many problems.

B. Advantages and Disadvantages of Basic Methods

Each of the basic methods and procedures for detection and response have certain advantages and disadvantages with respect to passenger related problems. Table 4-1 provides a summary of advantages and disadvantages for the four basic detection methods. Table 4-2 provides the same type of information for the four basic response methods. These advantages and disadvantages were used in the initial screening of candidate methods which might be applicable in accommodating the specific problem areas addressed in Table 3-1. They have also been included to aid the user of this document to address unique problems for specific applications which may not have been explored herein. A review of these advantages and disadvantages should provide some insight into selecting the best method in accommodating "site or system unique" problems that could be encountered.

C. General Applications for Basic Detection and Response Methods

There are some general guidelines that may be used when determining what basic detection and response method is most suited for specific problems in AGT. These are not absolute in every situation, but they do provide some rule-of-thumb guidance for application to PS & CS problems. The intent of these general guidelines is to provide a systems approach to the entire spectrum of passenger related problems. The broad base systems approach discussed here reduces the repetition of discussing each problem separately and will provide the user with a better understanding of the detailed recommended method and procedures for each problem as provided in Chapter 5.

TABLE 4-1. ADVANTAGES AND DISADVANTAGES FOR BASIC DETECTION AND REPORTING METHODS

PASSENGERS*

Advantages

- Inexpensive source for detecting and reporting problems.
- May provide a wider range of coverage at any given time than any other means.
- May provide, in some cases, the most rapid means of reporting a problem (non-equipment related problems where sensors, CCTV and roving AGT personnel are not available or inadequate).
- Requires no special equipment (station telephones and vehicle radios are standard equipment in AGT).
- Reduces manning requirements.

Disadvantages

- May not provide a reliable sole source of detecting/reporting problems because passengers:
  - May not want to get involved or take the time.
  - May not be knowledgeable of the system or trained to detect and accurately report problems.
  - May provide incorrect information to central control, thus compounding the problem.
  - May not be available during low usage times.
  - May not be able to report problems due to illness/injury or lack of time in severe emergencies.
  - May be fearful of reporting incidents related to crime or vandalism.
  - Detection and reporting times may be too slow.

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*Assuming that station courtesy phone and vehicle radios are readily available to report incident to central control.

TABLE 4-1. ADVANTAGES AND DISADVANTAGES FOR BASIC DETECTION AND REPORTING METHODS (CONTINUED)

AGT PERSONNEL

Advantages

- Are trained and equipped to detect and accurately report problems.
- Ability to immediately resolve problem (in many cases) when detected, hence faster response time in emergencies.
- Provides a source of security and reassurance to passengers with their presence.
- Have knowledge of the system and the ability to reason and make logical decisions that might not be possible by other detection and reporting sources.

Disadvantages

- Cost of hiring, training and equipping adequate number of personnel to provide required coverage.
- May override automatic controls and create a hazardous condition.

CCTV

Advantages

- Low recurring cost (compared to AGT personnel).
- Provides some degree of reassurance to passengers.
- May serve as a deterrent to crime and vandalism.
- Serves multiple functions in the detection of passenger and operational problems in station areas (See Chapter 6).
- May serve as fastest way to detect and verify occurrence of certain problems.
- Only practical way to visually monitor stations in a quick and easy manner and assess magnitude of problem.

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TABLE 4-1. ADVANTAGES AND DISADVANTAGES FOR BASIC DETECTION AND REPORTING METHODS (CONTINUED)

CCTV (Continued)

Disadvantages

- Initial cost of equipment and installation which may include backup generators. Impractical to provide total system coverage.
- Does not provide adequate coverage onboard vehicles until state-of-the-art makes vehicle installation practical.
- Creates a void in the detection process when CCTV equipment fails, power outages occur or acts of vandalism against the equipment occur.
- Cost of personnel watching monitors.
- Detection rates are proportional to monitoring personnel motivation/attentiveness and are less than 100%.
- Hard to detect certain types of equipment failures.
- Distorted viewing of large areas

SPECIAL SENSORS*

Advantages

- Low recurring cost.
- Fast detection or reporting capabilities for equipment related problems.
- Reduces manning requirements.
- Reduces constant monitoring requirement (unlike CCTV).
- Most reliable for around-the-clock operations (passengers or AGT personnel don't have to be present to sense condition, only to receive indication).
- Can be coupled to other equipment to provide automatic response to a sensed condition.

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*See next page for footnote.

TABLE 4-1. ADVANTAGES AND DISADVANTAGES FOR BASIC DETECTION AND REPORTING METHODS (CONTINUED)

SPECIAL SENSORS (Continued)

Disadvantages

- Moderate initial cost.
- Are not 100% effective in all applications.
- False alarms.
- Does not indicate magnitude of problem.
- Adds to system complexity and reduce reliability.
- Are specialized and not versatile.

*Special sensors may provide indications of malfunctions, out-of-tolerance conditions, abnormal occurrences or status of equipment with readouts at central control to denote the specific contingent condition. Examples include: smoke/fire, unscheduled door openings, inoperative turnstile, etc.

TABLE 4-2. ADVANTAGES AND DISADVANTAGES FOR BASIC RESPONSE METHODS

PROVIDING INSTRUCTIONS TO PASSENGERS VIA RADIO, TELEPHONE OR P A.

Advantages

- Available, reliable, versatile, fast and inexpensive means to resolve many passenger related problems.
- Requires no unique equipment.
- Reduces need to dispatch AGT personnel for minor problems.
- Allows assessment of problem magnitude by conversing with people directly concerned.
- Adds to sense of security -- "Someone cares".
- Provides a readily available and simple means by which passengers can seek assistance or receive positive feedback to a request.

Disadvantages

- Communications alone cannot resolve some problems, i.e., equipment failures, first aid, etc.
- Communication demands during delays and abnormal situations may become excessive.
- Some communication needs may be overlooked because of other more pressing demands.
- May require central control personnel to be multilingual.
- Excessive use of vehicle radios may interfere with other more pertinent radio traffic unless separate channels are used.
- Personnel costs
- Cannot guarantee personnel will provide proper verbal instructions/response under stress situations.

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TABLE 4-2. ADVANTAGES AND DISADVANTAGES FOR BASIC RESPONSE METHODS (CONTINUED)

DISPATCHING AGT PERSONNEL (MAINTENANCE, SECURITY, FIRE, FIRST AID, SUPERVISION, ETC.)

Advantages

- Only effective way to resolve some problems, e.g., equipment malfunctions, provide first aid, etc.
- Most versatile means to handle all types of problems (personnel are trained to handle a variety of problems).
- Often the safest means of problem resolution.
- Best means to assess total problem and commit proper resources to resolve it.
- Provides reassurance to passengers to have someone personally take charge and resolve their problem.
- Presence of AGT personnel may ward off the occurrence of a chain reaction of problems.

Disadvantages

- Training equipment costs and salaries for AGT personnel.
- Response times may be slower than other methods, e.g., communications, remote control, etc.
- Potential for human error.
- During major problem occurrences or several minor occurrences, the availability of personnel to handle minor problems may be marginal.
- Dispatching personnel may interrupt routine functions and may result in additional problem occurrences.
- Increased liability of untrained personnel.

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TABLE 4-2. ADVANTAGES AND DISADVANTAGES FOR BASIC RESPONSE METHODS (CONTINUED)

EXERCISE REMOTE CONTROL FEATURES FROM CENTRAL CONTROL

Advantages

- Most rapid means to temporarily resolve equipment problems or passenger demands.
- Reduces need to dispatch AGT personnel.
- Good for providing specialized but infrequently required functions.

Disadvantages

- Equipment and installation costs.
- Use is primarily restricted to equipment related problems.
- Remote control features are limited in scope and may only achieve partial problem resolution.
- Potential for increased reliability and maintainability problem

ALTER SYSTEM OPERATIONS

Advantages

- Often the best way to resolve problems which affect a large number of passengers or a significant amount of equipment.
- May be safest solution to some problems.
- Provides isolation of affected part of the system for maintenance, etc., with minimum impact on the rest of the system.

Disadvantages

- Cost of providing control features to alter system operations.
- Altering normal operations may create unforeseen problems, e.g., confusion of passengers and AGT personnel who are knowledgeable of routine procedures.

1. General Applications for Basic Detection and Reporting Methods

a. CCTV - Generally it is recommended that CCTV be used to detect or aid in detecting non-hazardous related problem where detection and reporting times are not critical to passenger safety or service for a significant number of passengers. These are typically non equipment related problems.

- Crowd conditions in stations
- Deterrence/detection of acts of vandalism
- General status of station equipment
- Soiled or littered stations
- Detecting and verifying need for special access (to elevators, restrooms and special wheelchair or employee gates)
- Verifying the occurrence of problems reported by other methods
- Supplementing search for lost children

In some cases, it may become necessary to rely upon CCTV to detect certain hazardous type problems when no other more suitable method exists. Typically these may include:

- Monitoring safety aspects of platform areas in open stations
- Monitoring vertical movement in station areas (stairs, escalators, etc.)
- Monitoring portions of the guideway which might be most accessible to passengers or other foreign objects.

For potentially hazardous occurrences, where either sensors or CCTV could be used for detection, the sensor is generally preferred. Sensor affords an automatic and instantaneous detection capability whereas CCTV detection rates become a function of monitoring personnel motivation and attentiveness.

b. Special Sensors (Malfunction, Status, or Abnormal Occurrences) - Use sensors to detect:

- Potentially hazardous occurrences where detection and reporting time are critical to passenger safety or impact on service may be substantial. These are typically equipment related and may include the following:

  - Fire and Smoke

  - Unscheduled door openings

  - Boarding doors that fail to open and close

  - Detection of inoperative equipment

    - turnstiles
    - ticketing equipment
    - graphics
    - elevators and escalators

c. AGT Personnel (Maintenance, Security, Supervision, etc.) Use AGT personnel to detect and report:

- Problems in areas where CCTV, sensors and passengers are not available or are inadequate. These include areas along the guideway, in parking lots, or low usage areas. They supplement all the other basic detection methods on an intermittent basis, but offer the distinct advantage of being able to resolve most problems upon detection.

d. Passengers (Affected or Assisting Passengers) Use passengers for detecting and reporting:

- Problem that directly relate to their personal well being. Primary application being in such areas as:

  - Lost or confused passengers
  - Lost or separated children
  - Lost articles
  - Need for first aid (most cases)
  - Special needs of the elderly and handicapped (E&H)

- They may also intermittently supplement detection and reporting of:
    - Inoperative station equipment and graphics
    - Soiled and littered vehicles and stations
    - Foreign objects in the system
    - Need for security

2. General Applications for Basic Response Methods

a. Instruct Passengers via Communications Means -

Use radio, telephone or P A to resolve non hazardous passenger problems where verbal instruction will suffice. Examples include:

- Instructing and directing lost or confused passengers

- Instructing and directing the illiterate passengers

- Providing temporary directional information when graphics fail

- Providing passenger reassurance during delays and emergencies

b. Dispatch AGT Personnel (Maintenance, Security, Medical, Fire, etc.)

Dispatch appropriate AGT personnel to potentially hazardous occurrences, situations where equipment has failed, where direct personnel aid i required, or where other response methods are inadequate. Examples include:

- Aid to the ill or injured

- Search for lost child

- Corrective action for inoperative graphics and equipment

- Smoke/Fire occurrences

- Foreign objects in guideway

- Aid to certain E&H

- Soiled vehicles and stations

c. Utilize Remote Control Features (Passenger Equipment Related)

Utilize remote control features where equipment failures impact passenger flow, or where special access is required for passengers or employees. Typical examples include:

- Commands to boarding doors when they fail to open or close.
- Freewheel or lock turnstiles as required.
- Allow access through special gates for employees or wheelchair users.
- Allow access to "limited access" areas or equipment, i.e., restrooms or elevators reserved for E&H.
- Start and stop escalators
- On-off control of special heaters or ventilation fans for open stations during adverse weather.

d. Alter System Operations *

Use commands that will alter system operations in an effort to avoid situations that may cause serious injury/death or may impact service for a large portion of the passengers, etc. These may typically include the following:

- Removing power from the guideway because of people or foreign objects in the guideway.
- Bypassing stations or other locations where hazards exist.
- Rerouting vehicles or making switch overrides to avoid queue, switch problems or damaged guideway.
- Alter vehicle speeds during adverse weather conditions.

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* These commands differ from the "remote control features" discussed earlier in that they may affect a significant portion of the system or passengers. The earlier discussed control features are more station equipment oriented and have less impact on the total system.

CHAPTER 5. RECOMMENDED METHODS AND PROCEDURES

A. Outline of Recommended Material

This section contains specific recommendations for accommodating the occurrence of passenger safety and convenience service (PS & CS) problems in AGT. Primary emphasis has been directed at providing recommended methods and procedures for detecting and resolving 14 identified PS & CS problems. However, other information is also provided and the following outline summarizes the areas addressed for each identified problem area.

- Definition of the Problem - Identifies and describes each problem area individually.

- Recommended Method and Procedure for Accommodating each Problem - Provides recommended detection and response methods and procedures for accommodating each defined problem. In many cases, a primary method is provided, along with alternate or supplementary methods.

- Negative Implications - A listing of limitations or negative implications of each recommended method and procedure is provided.

- Cost Considerations - Cost factors associated with implementing the recommended methods and procedures have been addressed. Those unique equipment and personnel needs which tend to drive costs have been provided when applicable. Specific dollar values have not been provided for two reasons:

    (1) Equipment and personnel needs vary greatly because of system size, type, location, and specific needs of each application.

    (2) Costs and salaries vary substantially with geographic locations and become outdated soon after being published.

- New and Untried Methods - Recent technologies have provided new possibilities in accommodating passenger problems. New and untried concepts are discussed where applicable.

B. Intent of Recommended Methods and Procedures

The recommended methods and procedures as contained herein have been determined to be realistic and effective means to detect and resolve specific PS & CS problems in AGT. These recommendations are based upon experience gained in both conventional and AGT applications, which were further refined through analyses during this study with respect to future AGT systems.

It should be noted that the primary intent of this document is to provide guidance associated with abnormal occurrences that have an impact on routine passenger services or safety. These abnormal occurrences may result from people or equipment related failures or may be associated with the presence of large crowds, severe weather or fires and related emergencies. The intent is not to provide a specific guidelines for handling routine passenger services and safety measures. It has been assumed that the equipment, facilities and operating procedures that provide these routine services are adequate during normal operations.

In many cases, the recommended methods and procedures consist of combinations of two (2) or more approaches to ensure adequate detection capabilities and to allow more than one response method depending upon the specific situation. It should be pointed out that the recommended methods and procedures are not 100% effective in all cases, as cost makes it impractical to fully accommodate all possible problems. The same applies to the over design of safety features in a system. A system can be designed so safe that it becomes ineffective in an operational environment. Therefore, the resulting recommended methods and procedures are intended to reflect a realistic blend of safety and cost cosiderations which are compatible with the state-of-the-art AGT environment.

For the most part, the recommended methods and procedures have been directed to applications for larger and more complex GRT systems since they represent a "worst case situation". What might be best for a GRT system with 20-30 stations, 50-60 vehicles and 10-20 miles of guideways, however, might not apply in its entirety to a simple SLT with 2 to 6 stations, 6 to 8 vehicles, and a few hundred feet of guideway. For small and relative simple SLT or PRT systems, something less than the recommended methods and procedures may be suitable. In any case, cost tradeoff studies will be required to determine the best method and procedure for a specific application, as well as the degree of automation needed. In some unique situations, it may prove more cost effective to accommodate some infrequently occurring problems by temporary manning rather than by automation.

Irrespective of the methods/procedures which are selected to accommodate PS & CS problems at any new system, it is important that they are well documented and adhered to. Detailed training and operational manuals should be readily available to all appropriate AGT personnel. Periodic reviews/assessment of the originally selected methods/procedures should be made and revised as required to insure a safe and efficient operation.

5-1. PROVISIONS FOR FIRST AID

A. Definition of Problem

Passengers having heart attacks or seizures, fainting, falling down stairs or on vehicles, etc., are not uncommon occurrences in transit systems. With the absence of station attendants and vehicle operators in AGT systems, new means are needed to detect, report and resolve the problems associated with the ill and injured. Provisions are needed to insure that ill or injured passengers will not go undetected at night or during low usage times. In addition, faster response times for serious illness/injuries may be required because detection times may increase and immediate assistance may not be as readily available as in conventional transit.

B. Recommended Methods and Procedures for Provision of First Aid

1. Detection and Reporting Method

A combination of the following:

a. For the majority of cases, both vehicle and station related, rely upon affected passenger(s) or assisting passengers to report need for first aid via station telephones or vehicle radio.

b. For station related occurrences, supplement the above by close monitoring of CCTV. Camera installations in stations should allow coverage of stairs, escalators, ramps and boarding areas since the frequency of injuries are highest in these areas. To further supplement detection of vehicle occurrences, consider CCTV camera installation in stations that will allow panning of vehicle interiors when vehicle is stopped at boarding area.

c. Both of the above methods can be supplemented by AGT personnel who may be roving the system. Inspection patterns by roving AGT personnel should emphasize those areas where CCTV coverage is unavailable or where detection by other passengers is low. At night or during low usage times, the need for systematic inspection of vehicles and stations becomes increasingly important, particularly if vehicle scanning is not feasible or station CCTV coverage is limited.

2. Response Method for Station Related Incidents

Once the need for first aid has been established, the response method for station related occurrences may vary depending upon the severity of the illness/injury.

a. Minor Occurrences - For minor occurrences such as small cuts, bruises, minor falls, fainting, etc., central control should dispatch nearest first aid trained AGT personnel immediately. Responding personnel shall have ready access to a first aid kit (either onboard the dispatched vehicle or located in station area). Central control should attempt to monitor affected passenger on CCTV to note arrival of medical personnel. Dispatched personnel shall render required treatment and request additional assistance as required. If needed, central should dispatch medical van or ambulance as required. In cases where it is uncertain as to the severity of the problem, central may wish to alert the ambulance service at the same time that AGT personnel are dispatched and dispatch ambulance only if needed.

b. Serious Occurrences - For cases known to be serious, e.g., passenger hit by vehicle, heart attacks, seizures, severe falls, etc., central shall dispatch available ambulance service and first aid trained AGT personnel, immediately. The first responsible AGT personnel to reach the site shall render necessary aid until the ambulance arrives and also take charge of the onsite activities. Central control should, however, have the overall responsibility of coordinating the entire response activity.

3. Response Method for Vehicle Related Incidents

Upon establishing the need for first aid onboard moving vehicle, the following should be considered:

a. Assess location of incident and severity of need (as best possible) to determine fastest or most appropriate means to respond.

b. For minor occurrences, dispatch first aid trained AGT personnel to the vehicle's next station destination. Deboard affected passenger and provide aid as required. Dispatch ambulance or other means of transportation only if injuries or illness proves more serious than originally perceived.

c. For more serious occurrences, several options should be considered pending individual situations and applications. Consider one of the following:

   - Dispatch ambulance to the vehicle's next station destination and deboard affected passenger for treatment/transportation to nearest medical facility.

   - If passenger cannot be moved, deboard other passengers and reroute the vehicle to the nearest siding and provide treatment in vehicle.

   - In some unique circumstances, it may be more expedient to reroute the vehicle with the ill or injured passenger to a station that is more readily accessible to medical provisions. Care should be exercised to ensure rerouting does not increase the probability of queue involvement, thereby delaying medical assistance.

C. Negative Implications

1. Recommended procedure for immediate detection of ill or injured passenger is not 100% effective under all circumstances. A lone incapacitated passenger in an uncrowded system could go undetected for several minutes.

2. Response times for outside ambulance service to respond to needs may be excessive in some situations, due to distances, traffic congestion, access to site, etc.

3. Cost of first aid training for appropriate number AGT personnel (security, maintenance, or supervisors) who specialize in response to emergency situations.

D. Cost Considerations

Cost makes it impractical for AGT systems to directly accommodate major or serious illness or injuries. Their role becomes one of providing immediate first aid for minor occurrences, with provisions to have the seriously ill or injured transported to nearby hospitals. In most situations, AGT operations can rely upon or time share the use of ambulances from adjacent airports, colleges, etc., or use local municipal ambulance services to transport ill or injured to nearby medical facilities. Therefore, the cost considerations associated with providing first aid in AGT systems include the following:

1. Cost of first aid kits, stretcher, etc., for stations or AGT motor vehicles.
2. Cost of training appropriate AGT personnel (security, maintenance, line or station supervisor, or evacuation and rescue personnel).
3. Cost associated with expenses of utilizing local ambulance service or time sharing other emergency equipment.

E. New and Untried Methods/Procedures

To insure that ill or injured passengers will not go undetected on vehicles during low usage time, consider CCTV coverage at strategic locations that will enable visual inspection of vehicle interiors. Consider the following approach:

> Provide a special CCTV camera(s) in a station that is common for all vehicles. The location of the camera(s) should allow viewing of the vehicle's passenger compartment during normal station stops. If a panning function is required, it should be limited to vehicle scanning and should not attempt to provide coverage of the station.

This approach would enhance the detection of problem occurrences onboard vehicles which is an area of significant concern. It would only provide detection coverage on an intermittent basis but it appears to be the next logical step short of CCTV onboard each vehicle. This type of installation could serve several other functions in detecting onboard occurrences. They include:

- Detecting soiled or vandalized cars.
- Detecting and searching for lost children or offenders of the system.
- Detecting and searching for lost articles left onboard vehicles.
- Verify that onboard graphics are operating.
- Verify that vehicle is empty prior to dispatching to maintenance, or prior to changing vehicle routes.

F. Additional Considerations

There are some additional considerations which should be addressed when dealing with provisions for first aid. Briefly summarized below, they include:

1. Policies/procedures for handling "delayed injuries" which occur some period of time after what was originally thought to be an "injury free" incident.
2. With more recent legal trends, treatment of ill/injured passenger by untrained/unqualified personnel are more susceptible to liable suits.
3. Early in design, coordinate with local authorities for applicable codes/recommendations/approval as related to handling of emergency situations (medical, fire, police, etc.)
4. To maintain proficiency in handling emergency situations, consider periodic mock accidents/disaster drills.

5-2. PROVISION OF AID AND INFORMATION TO LOST OR CONFUSED PASSENGERS

A. Definition of the Problem

The problem of lost or confused passengers* is without question, the most frequently occurring, non hazardous problem addressed herein. The problem is many-fold, but can be summarized by the following questions which are typical of the lost or confused passenger:

- What vehicle do I board to reach my destination?
- I'm not sure that I am on the right vehicle, how can I tell?
- Do I have to transfer vehicles? If so, how and where?
- I have lost my ticket, how do I exit the system?
- I can't exit because this machine says something about ADD-A-FARE.

These problems may arise from anyone or a combination of reasons such as:

- Inadequate information systems
- Passengers not reading instructions
- Mental/physical limitations of user due to age, language or other related handicaps.

Obviously these problems are more prevalent among first time and infrequent users. When they arise in conventional transit, station and vehicle attendants are readily available to assist. In the unmanned AGT environment, other means are required to detect and resolve the problems of the lost and confused passengers.

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* Not to be confused with lost or separated children, which is discussed later.

B. Recommended Method and Procedure for Aid to Lost or Confused Passengers

Note: The real key to this problem is one of preventing or minimizing its occurrence, through judicious planning and design of information systems (signs and graphics). However, when problems do occur, the following methods and procedures are recommended.

1. Detection and Reporting Method

For this type of occurrence it has to be assumed that most lost or confused passengers will detect and report their own problems. This will, of course, require readily accessible courtesy telephone and vehicle radios. In other cases, lost or confused passengers may be detected via CCTV, by AGT personnel, or reported by other assisting passengers. If detection occurs by CCTV, a PA announcement to that station can advise the affected passenger to contact central control via the courtesy telephone for assistance. The following procedure is directed towards passengers who contact central control for assistance via telephone or radio.

2. Response Method

a) Upon establishing voice contact with affected passger, determine specific nature of problem and attempt to resolve problem via 2-way communication. If in station area, attempt to monitor passenger on CCTV.

- For directional or destination information, attempt to provide verbal instructions or refer passenger to general information or destination signs.
- For fare related problems provide specific verbal instructions on how to use the equipment or refer to instructional signage.

b) Avoid dispatching AGT personnel to assist if possible. If age, mentality, handicap, or language barrier prevents instructional information via telephone or radio, it may be necessary to dispatch AGT personnel.

c) When applicable, verify by CCTV or by report from dispatched AGT personnel that problem has been resolved.

C. Negative Implications

During peak operational times and with the occurrence of other problems, the probability of detecting lost or confused passengers via CCTV or by AGT personnel is reduced. Time to instruct affected passengers and the availability of AGT personnel that can be dispatched to aid the lost and confused passengers may also be marginal.

D. Cost Considerations

Cost considerations associated with the recommended method and procedure for aiding lost or confused passengers are minimal. No unique equipment or personnel requirements are necessary since both are common to various other operational requirements. Some cost may be involved in training or hiring multi-lingual personnel to accommodate language barriers that may exist in some operational environments. The need for multi-lingual information brochures may also be a cost consideration.

E. New and Untried Methods

o Computerized Information Consoles in Stations

This concept is envisioned as a small console or control panel with a matrix of push buttons and a series of recorded messages. Each push button would activate a tape recording corresponding to potential problem areas that a passenger may encounter. Typically these tapes could cover such things as:

- Lost or Confused?
- Lost Articles?
- Fare Information?
- Destination Information?
- Inoperative Equipment?

The above recordings would provide specific information related to each of the above problems and suggest standard procedures so that passengers may resolve their own problems. The messages should be short and concise to minimize passenger listening time. Each recording would end with a statement to call central control if further assistance is needed. Using this approach would enable passengers to resolve some of their own problems and would reduce telephone inquiries to central control. It is also possible that a combined audio-visual presentation may be more desirable for some procedures. Some limitations associated with this concept include:

- Cost associated with providing adequate number of consoles
- Limited usage by one/few individual(s) at any specific time
- Provides a tempting "toy" susceptible to misuse or vandalism.

5-3. PROVISION OF AID AND DIRECTIONAL INFORMATION TO ILLITERATE

A. Definition of the Problem

In a transit environment, there are three classes of illiterate which may be encountered. These include:

- Illiterate - one who cannot read or comprehend graphics, signs or instructions for use of equipment or system but can communicate verbally.
- Non-English Speaking - foreign individual not fluent in English or other local language (written or spoken).
- First Time User - A first time user of transit, who may have limited intelligence, that is totally unfamiliar with transit operations and is overwhelmed or confused by the system.

The problem then becomes: How to accommodate the above classes of illiterate when normal information and directional systems have proven to be inadequate for their needs?

B. Recommended Method and Procedure for Aid to Illiterate

1. Detection and Reporting Method

(a) Rely primarily upon CCTV coverage in station areas since most problems associated with the illiterate will probably occur upon entering the system. Coverage should emphasize areas where information signs, ticketing equipment, and boarding graphics are located.

(b) Also rely upon illiterate passenger(s) or assisting passengers to report need for assistance via vehicle radio or station courtesy phones. Even if coherent communications are not possible, central control will be alerted to a potential problem.

(c) Roving AGT personnel may serve as another detection source but on an intermittent basis.

2. Response Method

(a) If detection occurs by CCTV, direct affected passengers via station PA to use courtesy phone if assistance is needed.

(b) Once 2-way communication has been established, attempt to resolve problem through verbal instructions. The hiring of multilingual personnel at central control may be desirable for some system applications. In some applications, a multilingual to English translation glossary or dictionary (typical of those used by travelers) should be available at central control.

(c) If verbal instructions fail, dispatch best qualified AGT personnel to personally direct or instruct passenger as required. See additional consideration in paragraph F.

C. Negative Implications

1. It becomes difficult/impractical to hire AGT personnel who are fluent in all foreign languages which may be encountered.

2. The use of translation glossaries/dictionary is time consuming and may create workload problems at central control.

D. Cost Considerations

The unique cost associated with the recommended method and procedure, are those associated with translation glossaries, supplying special multilingual brochures or signage as required for special applications.

E. New and Untried Methods

To help deal with problems in which severe foreign language barriers prevent resolutions by AGT personnel, a cooperative agreement with the Language Department of local universities may be feasible. Telephone communication between AGT personnel (or the affected passenger) and the Language Department (professor or students) may provide a means by which difficult language related problems could be solved. It is impractical to believe that the college could provide around-the-clock service, but during daytime operations, their assistance may prove helpful.

F. Additional Design and Operational Considerations

The following additional considerations are provided for accommodating the informational needs of the illiterate and should be accessed for specific application.

- The use of standard international graphic symbols are recommended to not only aid the illiterate but also all other users. In addition to normal usage for directional/informational purposes, the use of international symbols should be emphasized in identifying hazardous situations/locations.

- For some applications where a large cross section of foreign travelers may frequent a system, a special information center may be required. For airport applications, the foreign information center typically located at airports may fulfill this need. In some unique applications, the need for multilingual information brochures may be required.

- For systems where there is predominence of first time users, a First Time on Transit Information Board with complete system details and take-along pamphlets may be desirable.

- European systems have had much success with the use of simple pictures and numbers along with a few well selected words to address special information needs.

- Supplement visual displays with audio announcements for critical informational/directional information.

5-4. PROVISION OF AID IN RECOVERING LOST OR STRAYED CHILDREN

A. Definition of the Problem

On an unpredictable and somewhat infrequent basis, children become lost or separated from their parents while using transit systems. In conventional transit operations, station attendants and onboard vehicle operators play a key role in reuniting children with their parents. The absence of these transit personnel in the AGT environment will dictate the need for new methods and procedures for detecting and resolving this problem. The following address this problem and recommends possible solutions.

B. Recommended Methods and Procedures for Lost or Separated Child

1. Detection and Reporting Method

A combination of the following:

a. Normally, rely upon the parents of the lost child to report incident to central control via station telephones or vehicle radio. The child or assisting passengers may also aid in some situations.

b. Supplement the above by monitoring CCTV in stations and consider camera locations that will allow panning of vehicle interior if possible.

c. Supplement both of the above by relying upon AGT personnel to aid in detection process particularily where CCTV is not available. Easily recognized uniforms for all AGT personnel would enhance possibility of affected passenger seeking aid from proper personnel. At night or during low usage times, roving personnel should make systematic inspections of vehicles at some regular interval if vehicle interiors cannot be scanned by station CCTV.

2. Response Method

a. When report is received by central control regarding a lost or strayed child, obtain the following information if possible:

Child's Description - Name, age, height, weight, clothing characteristics and other distinguishing features.

Parent's Name, present location, phone numbers, intended destination of parents and child, where separation occurred, time of separation, vehicle number, etc.

b. Instruct parents to stay at present location (assuming parents report problem).

c. Alert security, roving maintenance personnel, line and station supervisory personnel (via radio and telephone) and provide details of event.

d. Make "all" train and station PA announcements.

Request lost child or assisting passengers to notify central control via vehicle radio or station telephones.

e. Constantly monitor CCTV for possible detection of child.

f. When lost child or assisting passenger responds, request location and instruct child or passenger to remain at present location.

g. Dispatch closest AGT personnel to location to verify identity. *

h. Notify "AGT search personnel" to terminate search if identity is correct.

i. Contact parents and direct them to the child's location. Have AGT personnel remain with child until parents arrive.

C. Negative Implications

During peak times and with the occurrence of other operational

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*Note: In some situations associated with small PRT or SLT systems, when parents and children are knowledgeable of the system, it is feasible that reunion instructions may be given via radio or telephone, thus negating the need to dispatch AGT personnel.

problems, the availability of AGT personnel to respond to "lost child situations" may be marginal because of more pressing system problems.

D. Cost Considerations

Cost considerations associated with the above recommended method and procedure are minimal. No unique equipment or personnel requirements are necessary since both are typical of AGT transit operations.

E. New and Untried Methods

1. Highly publicized procedure for lost/separated passengers to go to a centrally located station or Lost Persons Center to reunite themselves with their separated party.

2. See paragraph E of Chapter 5-1, "Provisions for First Aid", for new and untried method that is applicable to detecting and searching for lost or separated children.

5-5. PROVISION OF AID IN RECOVERING LOST ARTICLES

A. Definition of Problem

In conventional transit operations, vehicle and station personnel play key role in assisting passengers to find articles left on vehicles or in stations. Even in this type of manned transit environment, many lost articles are never returned to their rightful owner unless a timely and systematic search is conducted almost immediately. In an unmanned AGT environment, the probability of recovering lost articles will undoubtedly decrease unless adequate methods and procedures are used to prevent type of problem.

B. Recommended Method and Procedure for Recovery of Lost Articles

1. Detection and Reporting Method

Primarily rely upon passengers who lose articles to report such occurrences via station courtesy telephone and vehicle radios. If drop line telephones are not provided, the telephone number of the Lost and Found Department should be included on:

- o General information signs in stations
- o Telephone listings beside courtesy phones in stations
- o Infomation brochures, wallet size route cards or other such published literature.

AGT personnel, other passengers, and CCTV may also serve as other sources to detect and report lost articles, but probably on an infrequent basis. Some articles may also be found by janitorial personnel during scheduled cleaning.

2. Response Method

Every attempt should be made to reduce the burden on central control operators with respect to handling lost and found articles. If possible, all telephone inquiries related to lost articles should be directed to and handled by a designated Lost and Found Department. Central control involvement should be limited to primarily two areas:

- When passenger reports losing an article via vehicle radio, central control should refer passenger to Lost and Found Department to avoid lengthy radio transmission which will tie up radio channels.
- When Lost and Found Department requests assistance from central control to search for valuable article thought to still be onboard a vehicle and in a station. Central's effort should consist of alerting AGT personnel (security, maintenance, janitorial, line supervisors, etc.) and monitoring CCTV in station areas.

It is not recommended that AGT personnel be dispatched to conduct an indepth search for all reported lost articles. This can become a time consuming job and interferes with other operational duties. However, all AGT personnel who are typically in the system should be cognizant of lost articles and send or deliver them to the Lost and Found Department as discovered. When passengers report that they have found a lost article or central control has located a lost article via CCTV, it may be necessary to dispatch available personnel to recover it. All articles turned into the Lost and Found Department and not claimed within 6 months should be auctioned to the highest bidder pending local policies.

C. Negative Implications

- Potential problem of tieing up AGT personnel when searching or retrieving lost articles; hence, other more pressing operational duties may suffer.

- Inability to easily detect lost articles left onboard vehicles.

D. Cost Considerations

Costs associated with implementing the recommended methods and procedure are minimal. The Lost and Found Department for an AGT system may occupy only a few square feet of floor space in the Transit Administration Facility or other related transit facilities. Telephone calls can be handled by existing switchboard, secretarial, or administrative personnel. Equipment needs such as telephone, CCTV, 2 way radio communications, etc., are not unique for this method and procedure and are required for other operational purposes.

E. New and Untried Methods

See paragraph E of Chapter 5-1, "Provisions for First Aid", for new and untried method that will enhance detection of lost articles onboard vehicles.

5-6. PROVISION OF AID TO ELDERLY AND HANDICAPPED (E&H)

A. Definition of Problem

Under normal operations, most newer or future transit systems are or will be essentially barrier-free to the E&H user. However, in some situations associated with emergencies, equipment malfunctions or other contingencies, these barrier-free systems may present some obstacles which cannot be negotiated by the unassisted E&H; thus, special assistance will be required. Situations associated with emergencies, inoperative elevators or escalators, access through special wheelchair gates, and improper vehicle leveling at boarding platforms are but a few areas where aid may have to be provided. The problem then becomes, "How do we best provide aid to the E&H with the occurrence of abnormal situations, in a system which, under normal conditions, is barrier-free?"

B. Recommended Methods and Procedures for Aid to Elderly and Handicapped

1. Detection and Reporting Method (General)

- Rely upon E&H or assisting passengers to report problems encountered via station telephone or vehicle radios. Special emphasis during design phase must ensure accessibility to these communication devices by E&H population.

- Supplement the above with CCTV monitoring in station areas where special wheelchair access gates or limited access elevators are required and where inoperative equipment may create temporary barriers. Provide equipment status and malfunction sensors on special equipment where CCTV is not available.

- Additional detection and reporting capabilities should also be available from AGT personnel on a random basis.

2. Response Method (General)

a. If detection occurs by CCTV, direct affected passenger, via station PA, to use courtesy telephone for assistance.

b. Once two-way communication has been established, attempt to resolve problem through verbal instructions:

- Provide necessary instructions, information or directions
- Suggest alternate solutions to problems

c. If appropriate, initiate remote control features; e.g., allow access to elevators, unlock wheelchair gate, etc.

d. If verbal communications or remote control features are inadequate, dispatch nearest AGT personnel. Advise passenger that assistance is coming and continue to monitor CCTV until problem is resolved.

3. Detection and Response Method (for the Deaf)

a. First, it has to be assumed that a deaf passenger will, to some degree, rely upon visual cues or the actions of other passengers during abnormal or emergency occurrences. If other passengers are not available, a deaf passenger may initiate a "request for communication" from onboard a vehicle, if a problem arises. Although two-way communications may not be possible, central control will be alerted to a potential problem and should:

- Observe the vehicle at the next station via CCTV to detect the need to dispatch AGT personnel to investigate.
- If the vehicle is stopped in the guideway, central control should advise the AGT personnel who is normally dispatched to a stopped vehicle to investigate the non-response to the request for communications.

b. For station related occurrence, central control should monitor CCTV to observe passengers who have initiated telephone calls. If two-way communication is not possible, viewing the originator of the call should allow central control to determine if the call is a prank or valid and if there is a need to dispatch assistance.

C. Negative Implications

- Inability to detect, in a timely manner and with regularity, problems onboard vehicles, in certain station area or in areas between the station and parking lot. CCTV onboard vehicles will improve this problem onboard vehicles when state-of-the-art allows.

- Cost of providing adequate CCTV coverage, remote monitoring and control of critical equipment in areas where potential E&H barriers may occur.

D. Cost Considerations

No attempt is made here to address the cost of providing a barrier-free system for the E&H under normal operations. Instead, cost considerations here will address those unique items that will aid in detecting and resolving E&H problems that relate to abnormal or contingent occurrences in an otherwise barrier-free system. These occurrences include problems associated with such things as inoperative elevators, escalators, wheelchair gates, improper vehicle leveling at boarding areas, etc.

The following is a summary of the major cost drivers with respect to aid for E&H under contingencies situations:

- Additional CCTV station coverage of areas where equipment malfunction may result in barriers to E&H; i.e., elevators, escalators, boarding area, wheelchair gates, etc.

- Provisions for station and vehicle communication system which are accessible and usable to all types of E&H.

- Provisions for remote control features that will aid the E&H; i.e., access through special wheelchair gates, access to "limited access" elevators, etc.

E. New and Untried Methods

No new and untried methods are provided; however, some additional design and operational considerations are provided in paragraph "F".

F. Additional Design and Operational Considerations

The following are features which should be considered in attempting to accommodate the E&H. These include features which will not only make a system barrier free, but also include considerations and features to ensure proper aid to the E&H when temporary barriers occur due to equipment failures or other abnormal conditions.

Parking Related Facilities

- Close in reserved parking properly marked with International Symbol signs.
- Wide parking spaces to allow wheelchair access.
- Cutaway curbs or ramps to station.
- Minimize travel distances between parking lot and station.

Station Related Considerations

- When possible, provide level entryways to stations (or)
- Provide ramps, elevators, escalators with chair lifts, etc. as required.
- Consider controlled access to elevator with "access alert button" and CCTV coverage.
- Consider transparent elevators or elevator doors.
- Provide guard rails and hand hold as required.
- Provide non-slip floor material at critical areas.
- Consider automatic station entry door that slide laterally.
- Consider textured or colored pathways or floors as directional aid to blind and elderly - from entry to ticketing area to turnstiles and then to the platform. Provide special travel lanes for E&H if possible.
- Change and ticketing equipment, turnstiles, wheelchair gates, telephones, water fountains, and restroom facilities must be compatible for E&H users.

- If special wheelchair access gates are used, provide remote control capability from central control with CCTV coverage.

- Information needs for E&H:

  - Consider visual presentation supplement with audio when possible.

  - Consider the color blind when color coding graphics and route information.

  - Provide Braille signage as required.

- Consider seating in stations for the elderly. Seat locations relative to boarding areas and associated station dwell times should be considered.

- Closed platforms are preferred but if open platforms are used, provide appropriate safety considerations: guard rails, textured floor material along guideway for the blind, imbedded flashing lights or platforms which slope away from the guideway or track (1° grade).

- Minimize walking distances in stations.

- Provide transfer times that are reasonable for E&H.

Vehicle Related Considerations

- Provide vehicle leveling at station platforms and close horizontal tolerance between vehicle and platform to accommodate wheelchair, cane and crutch users.

- Provide floor area near doors to accommodate wheelchairs with tie downs.

- Consider reserved seating near door for E&H.

- Provide adequate handholds; i.e., on seats, vertical stanchions, etc., which are accessible to E&H.

- Seat design should consider needs of E&H; i.e., arm rest, seat pan angle, handhold, padded surfaces, etc.

- Use of non-slip floor surfaces on vehicles.

- Vehicle radio communications, passenger emergency buttons, emergency stop actuation devices, door hold button, fire extinguishers, and emergency door latches should be accessible to and operable by E&H.

- Vehicle information sources should consider needs of E&H (audio and visual).
- Consider warning tones prior to door closure, starting and stopping.
- Vehicle and station dwell times should be adequate to allow boarding and deboarding of E&H.
- Provide door widths to accommodate wheelchairs and equipped with touch sensitive edges.
- Consider E&H provision for emergency egress situations; i.e., emergency door operations and widths, emergency stops, etc.

Other Considerations

- Provide special educational classes and information brochures for E&H on how to use the system under normal and emergency conditions.
- Discount fares for E&H.

The above listing is by no means complete, nor does it provide adequate details for each consideration or feature. The following references are provided as a source of further details.

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5-7. INOPERATIVE DIRECTIONAL OR DESTINATION GRAPHICS

A. Definition of the Problem

In an AGT environment, particularly large and complex systems with multiple routes and vehicles that do not serve all destinations, the need for multiple, dynamic destination graphics becomes more prevalent. Because dynamic graphics are inherently more complex than placards or simple backlighted signs that are typical of conventional transit, there is an increased probability of failure or incorrect information. Every step should be taken to increase reliability of electronic graphics and to "Murphy" proof these systems as much as possible.. To ensure timely detection of failed graphics, as well as means to ensure adequate destination information to the passengers until corrective action can be taken, the following recommended methods and procedures are provided.

B. Recommended Method and Procedure for Inoperative Graphics

1. Detection Method (for Multiple Route Systems)

It is desirable that dynamic graphic displays be equipped with malfunction sensors and corresponding alarms and indicators at central control. This approach affords instantaneous detection of both vehicle and station graphic failures which, if undetected, could impact passenger service for numerous passengers.

In smaller systems, where onboard graphics are not used and CCTV coverage of the boarding graphics is available and continuously monitored, CCTV could suffice as a less desirable but acceptable method of detection.

2. Response Method

- Upon receipt of station graphics malfunction indication at central control, view CCTV monitor for affected station to verify malfunction.
- Dispatch maintenance for corrective action and dispatch other AGT personnel to provide necessary destination information for arriving vehicles until condition can be corrected.
- Until station can be manned, central control shall provide necessary destination information per station PA announcements as required. In relatively small systems, manning the station may not be necessary and required destination information may be handled by PA or destination information onboard vehicles.

- For vehicle graphic failures, manning the vehicle may not be required if automatic onboard announcements or other forms of static route information is provided on the vehicle, or if approaching stations can be readily identified from onboard the vehicle. If these are not provided, central control should provide destination information via vehicle PA until maintenance provides minor corrections or establishes the need to remove the vehicle from service.

C. Negative Implications

- Cost of procuring and installing malfunction sensors
- Potential for false alarms
- Potential high workload demands on central control personnel to make required PA announcements with multiple graphic failures. This would apply to multiple route systems and would exist until affected stations could be manned.

D. Cost Considerations

Cost associated with implementing the recommended method includes the expense for malfunction sensors in each graphics display, alarms and indicators at central control, and wire installation from each station graphics display to central control.

E. New and Untried Methods

The use of automatic announcements onboard vehicles to inform passengers of the next approaching station is currently being used in AGT. There is no reason why this feature could not be extended to station PA announcements. The automatic station announcement could inform awaiting station passengers of the destinations served by the approaching vehicle. Standard announcement would be required for each route and the appropriate message could be initiated from the same logic that the station graphics use. This approach would supplement station graphics under normal operations and would serve as a back-up when station graphics have failed. It would also aid the visually handicapped and those people who do not read signs.

5-8. INOPERATIVE EQUIPMENT

A. Definition of the Problem

In conventional transit operations, station attendants and vehicle operators are readily available to detect and in some cases correct various equipment malfunctions. These include such things as inoperative vehicle and station doors, turnstiles, ticketing equipment, change machines, elevators, escalators, etc.

Of these equipment problems mentioned, inoperative vehicle/station boarding doors presents the area of greatest concern in AGT. Doors failing to open and close properly during normal berthing operations can result in vehicle queues and thereby affect service for a significant number of station and vehicle passengers. Inoperative turnstiles, fare equipment, escalators, etc. may slow passenger flow in one station, but with the availability of other similar station equipment, the impact is generally less significant. In the relatively unmanned AGT environment, personnel will not be readily available to detect and resolve equipment failure occurrences. Therefore the following recommendations are provided to readily detect and rectify these problems with minimal passenger inconvenience or service delays.

B. Recommended Methods and Procedures for Accommodating Inoperative Equipment

1. Detection Method

a. For door malfunctions or abnormal operations, sensors with alarms and indications at central control are required to denote malfunctions or unscheduled openings* for station and vehicle boarding doors and station and vehicle emergency doors.

b. For station equipment listed below, sensors with alarms and indications at central control are highly desirable but not an absolute requirement. Consider sensors and indications for the following:

- Turnstiles - sensors and indications to denote malfunction or abnormal occurrence e.g., turnstile rejects coin or magnetic card, or is frozen or freewheeling.

- Ticketing or Change Equipment - sensor and indication to denote that equipment has failed to issue ticket or change. Low level indications, to denote that ticket or change supply has reached a predetermined low level, should also be considered.

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* Unscheduled door openings are not true door malfunctions but will be discussed as such since they reflect an abnormal occurrence and can be potentially hazardous.

- Add-a-Fare Equipment - sensor and indication to denote that add-a-fare equipment is inoperative.
- Elevators/Escalators - sensor and indication to denote that elevator or escalator has stopped or malfunctioned.

c. If sensors are not provided for the above, CCTV coverage of all station equipment and continuous monitoring of each is required. Signs should be provided to refer passengers to readily accessible courtesy phone to report problem occurrences to central control.

2. Response Method (For inoperative turnstiles, ticketing equipment, and change machines but not doors)

a. Upon indication of equipment malfunction at central control, attempt to observe and assess incident on CCTV.

b. By initiative of passenger (as directed by signs) or by request from central control via station PA system, establish verbal contact with affected passenger by courtesy telephone. Request details of problem and attempt resolution by one of the following:

- o Initiate command from central control to remedy immediate problem, e.g., freewheel turnstile, etc.
- o Instruct passenger on solution to problem, alternate procedure or to use other available equipment.
- o Instruct passenger on rebate or refund procedure for recovering lost money.

If the above are inadequate, or if there is an obvious equipment malfunction requiring maintenance, dispatch AGT personnel and advise awaiting passenger that assistance is coming.

3. Response Method (For malfunctioning station and vehicle boarding doors)

   a. Upon receipt of door malfunction indication at central control attempt to observe and assess the situation on station CCTV.* (Vehicle stops in station and vehicle/station doors fail to open or close).

   b. Alert maintenance of potential problem.

   c. Initiate door command from central control (cycle or close doors).

   d. Observe results of command on CCTV.

   e. If results are positive, continue to monitor station door operations when next vehicle arrives and also observe affected vehicle at next station to determine if problem is vehicle or station related. Dispatch maintenance to appropriate site as required if problem persists.

   f. If commands from central control are ineffective, dispatch maintenance personnel and make station and vehicle PA announcements to affected passengers that assistance is coming.

   g. Continue to monitor situation on CCTV until resolved.

4. Response Method (For unscheduled vehicle or station door openings)

Upon receipt of an unscheduled door opening indication at central control:

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* For systems using automatic sequencing CCTV, (2 or 3 CCTV monitors at central control which automatically sequence through various cameras throughout the system) any station malfunction should automatically display coverage from the camera in the affected station.

a. For Station Occurrence

- o Dispatch nearest AGT personnel and attempt to verify occurrence on CCTV to determine if indication is valid and if people are entering the guideway.
- o If people are detected or suspected of entering the guideway, remove power to the guideway immediately.
- o If evidence indicates that no exit was made, continue to monitor CCTV until dispatched AGT personnel can verify the need to remove guideway power or provide an "all clear".

b. For Onboard Vehicle Occurrences (unscheduled door openings onboard moving vehicles should automatically stop vehicle, and provide location and vehicle identification of affected vehicle at central control).

- o Contact affected vehicle via vehicle radio and dispatch nearest AGT personnel immediately.
- o Attempt to verify via passenger communications, if someone has deboarded vehicle or if door was inadvertently opened.
- o If passengers have evacuated vehicle or there is no verbal response, remove power to the guideway.
- o Have dispatched AGT personnel investigate and verify if and when the guideway is clear. Make appropriate PA announcements to affected vehicles and stations as required.
- o When guideway has been secured, restore power, reset vehicles and resume service.

C. Negative Implications

- o Initial cost of equipment and installation to provide remote sensing and control capabilities for doors, turnstiles, and related station equipment.

- Removing power from the guideway for unscheduled door openings is a desirable safety feature but operationally it substantially prolongs service interruptions.

D. Cost Considerations

Initial cost associated with equipment and installation of special status and malfunction sensors and related remote control features at central control are significant. However, when considering long-term operational cost to dispatch maintenance for minor problems which could be handled from central control, as well as faster response times to passenger needs, these initial cost factors become more practical. The following is a list of those items or equipment which are the primary cost drivers associated with implementing the recommended methods and procedures.

1. Vehicle/Station Boarding and Emergency Doors

- Sensors and indicators for door malfunctions and unscheduled door openings
- Control feature to command boarding doors

2. Turnstiles

- Malfunction sensor and indication at central control
- Remote control feature to freewheel or freeze turnstile

3. Ticket Issuing Equipment and Money Changers

- Malfunction sensor and indication at central control
- Low level status sensor and indication (desirable but optimal)

4. Add-a-Fare

- Malfunction sensor and indication at central control
- Sensor to verify fare remaining on ticket with readout at central control

5. Elevator/Escalators

- Malfunction/status sensor with indications at central control
- Command feature to stop and start escalator
- Command feature to allow entry to controlled access elevators

E. New and Untried Method

- Unscheduled Door Openings

Any unscheduled vehicle door opening is an area of great concern because of the hazards associated with people making uncontrolled evacuations into the guideway. Typically any unscheduled vehicle door opening will result in automatic vehicle breaking and either automatic or manual removal of power from the guideway. Frequently false sensor indications or passengers inadvertently leaning on doors will stop vehicles and remove guideway power unnecessarily. Automatic power removal is a desirable safety feature, but in these situations have proven to be operationally undesirable because of unnecessary and prolonged service interruptions. Most sensing systems use a microswitch in the door to sense door openings - hence a one step action can stop a vehicle and remove guideway power. A more logical and fool proof system would require a 2 step action to stop a vehicle and remove power. First, a latch or cover sensor should be provided over the door handle. Removing this cover prior to actual door opening should initiate vehicle stoppage. This would prevent people from being thrown out of the decelerating vehicle. The second sensor could be a pressure sensitive device mounted on the exit steps or platform that would only be activated when a deliberate attempt is made to exit the vehicle. This sensor would automatically remove power from the guideway when activated.

5-9. SOILED, DAMAGED OR VANDALIZED VEHICLES AND STATIONS

A. Definition of the Problem

During routine daily transit operations, vehicles and stations will become soiled, littered, or vandalized, thereby, creating conditions which may discourage ridership if not corrected on a timely basis. These nuisance problems may arise from deliberate acts of vandalism or conduct or may be associated with routine unintentional mishaps. They may include such things as spilled food or drink, vomit, urine, defecation, broken windows, slashed seats or interiors, or accumulation of an excessive amount of debris. In AGT, deliberate acts of misconduct may tend to increase because of its relatively unmanned nature. To help encourage increased ridership in AGT systems, means of detecting and resolving these problems in a timely fashion will be required.

B. Recommended Method and Procedure for Soiled Vehicles and Stations

1. Scheduled Cleaning Recommendation

It is recommended that all vehicles and stations be cleaned on a daily basis. Preferably routine cleaning should be accomplished at night or when service demands are low to ensure minimal impact on passenger service or passenger inconvenience. For abnormal occurrences, dictating the need for more frequent attention, the following is recommended:

2. Detection and Reporting Method

In general, rely upon roving AGT personnel and passengers to report need for special cleaning and repairs. CCTV may aid the detection process in stations and to some degree onboard vehicles if station camera will allow panning of vehicle interiors.

3. Response Method

Once a problem has been reported, dispatch maintenance or janitorial personnel to problem area (vehicle or station) to assess type and severity of problem. Once assessed, three options normally exist:

a. For relatively minor occurrences (spilled food or drinks, excess debris, minor graffiti, etc.), corrective action may be taken onboard a vehicle or in a station without interrupting service or passenger flow.

b. For moderate problems (vomit, urine, defecation, etc.), deboard passengers at nearest station and route vehicle to nearest siding for corrective action. For station related incidents, isolate affected area as required, but attempt to minimize affect upon passenger flow.

c. For major occurrences (broken windows, slashed seats/ interior or severe graffiti), deboard passengers at nearest station and reroute vehicle directly to maintenance. For stations, rope off affected area or close station completely as required.

The final decision as to the corrective action taken (whether a vehicle is removed from service) may well be influenced by:

- Potential hazard if condition goes uncorrected
- Availability of spare vehicles
- Passenger demands at time of occurrence.

C. Negative Implications

During peak operational times and with the occurrence of other operational problems, the ability to detect and properly respond to minor nuisance problems may be marginal.

D. Cost Considerations

There are no unique equipment or personnel costs for implementing the recommended methods and procedures, that are not already standard for AGT.

E. New and Untried Methods

See paragraph E of Chapter 5-1, "Provision for First Aid" for new and untried methods that will enhance detecting problems associated with soiled or vandalized vehicles.

5-10. FOREIGN OBJECTS IN THE SYSTEM

A. Definition of the Problem

Even though AGT systems typically operate in a controlled environment and on guarded right-of-ways, foreign objects will on occasion be introduced (either deliberately or unintentionally) into the system. Animals, people and other foreign objects have created and will probably contine to create operational problems, particularly when introduced into the guideway. People in the guideway present a problem of major concern to any transit operation but become even more critical in AGT. Animals being struck by ATC vehicles have not only caused service interruptions and damage but also have created an area of great controversy among local patrons. Cans, rocks, bottles, aluminum foil, luggage, etc. have been responsible for power and signal interruptions and, in some cases, rail and tire damage that have resulted in service delays.

The key to the problem is through preventative measures during the design phase. However, cost may preclude a 100% effective approach. Another solution is to provide detection sensors onboard each vehicle which will detect and stop the vehicle prior to impacting a foreign object. Technology to provide this capability in a cost effective manner appears unrealistic at this time. A partial solution to the problem is to equip vehicles with impact sensors. This approach does not prevent impact but prevents prolonged dragging of an object by stopping the vehicle automatically after impact. This section will therefore be devoted to existing means of detecting and removing foreign objects from the system, with exclusive emphasis on objects introduced into the guideway because of the potentially more hazardous effect.

B. Recommended Methods and Procedures for Accommodating Foreign Objects in Guideway*

1. Detection Method (Assuming system is located in a relatively uncontrolled environment and vehicles are equipped with foreign object impact sensors which automatically stops the vehicle after impact).
   a. Foreign Object Impact Sensor contacts foreign article which automatically initiates vehicle braking.

   b. Central control receives indication of event which includes type of discrepancy, vehicle identification number and vehicle location.

2. Response Method
   a. If central control receives a report that object impacted is a person, or there have been reports of people in the guideway, remove power from the guideway immediately upon receiving impact indications and dispatch medical, security and maintenance personnel. Otherwise:

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*See paragraph E of this section for additional considerations.

b. Dispatch Maintenance (or closest AGT personnel) to assess the situation as soon as possible.

c. Dispatched personnel should assess occurrence upon arrival and convey overview of situation to central control:

   o Object impacted

   o Need to remove power (to remove object or prevent further damage or injury)

   o Personal injury (need to dispatch medical assistance

   o Vehicle or rail damage (need for additional maintenance manpower and equipment)

   o Estimated time to restore service (if severe damage is involved, a tug, rescue vehicle, or backup transportation may be required).

d. Depending upon severity of the occurrence, central control shall assess need to reroute or divert other vehicles away from occurrence site.

e. As required, make vehicle and station PA announcements to affected passengers. Advise passengers to remain onboard vehicles for their own personal safety and to prevent further delays.

f. Await detailed damage or injury assessment from AGT personnel at the site. If corrective action is anticipated to exceed 20-30 minutes, dispatch backup transportation and consider evacuation of vehicle passengers. Make every reasonable attempt to get stranded vehicles to the nearest stations if evacuation is required.

g. Once corrective action has been performed, receive verification from problem site that guideway is free of personnel and restore power. Reset individual vehicles and resume service. Make PA announcements to affected stations that service has been restored.

For some system locations and guideway types, where guideway protection against deliberate acts of vandalism (throwing objects in the guideway) may be difficult to provide, the need for passenger emergency stop buttons on vehicles may be valuable.

The incorporation of such a device is controversial and the decision to implement them should be thoroughly assessed based upon each specific application. Positive aspects of such a feature includes the potential for passengers to stop vehicles prior to impacting foreign objects in the guideway or to allow passengers to stop a burning vehicle and egress to safety in some systems. Some negative aspects include: (1) passengers may not be knowledgeable enough to know "how" and "when" to use it, (2) it allows partial control of the system by the passenger, which could be undesirable during some emergencies, (3) passengers may abuse its use and create unnecessary service delays.

3. Detection Method (Assuming system is located in a relatively controlled environment and vehicles are not equipped with foreign object impact sensor; in this case, vehicle impact with foreign object will not necessarily stop vehicle)

   a. Rely upon AGT personnel and passengers to detect and report foreign objects in the guideway via vehicle radio, handie talkie, station telephone or emergency phone along guideway. In some applications, CCTV may provide some aid in station or platform areas.

   b. When reported, attempt to verify/confirm the type and location of foreign object.

4. Response Method

   a. If reported prior to impact and object is a person or animal, or of adequate size to cause damage, and the approximate location is known, (1) remove power to appropriate guideway section immediately. If specific location is known and object is non-living in nature and small, it may prove more feasible to (1) initiate a switch override command to divert vehicles around the affected area, or (2) issue a stop command to the first vehicle approaching the problem area. Under any circumstances, dispatch maintenance to site of reported problem and adhere to the following:

- If foreign object is small, and vehicle traffic in area is minimal, the object may be removed by experienced maintenance personnel without de-energizing power* or stopping vehicles.

- For larger articles, people, or animals in the guideway in which power has been de-energized, instruct maintenance to remove object and inspect guideway, power/signal rails and vehicles for possible damage.

b. If impact has occurred, stop vehicles in affected area and adhere to Response Method (on previous page) for vehicles equipped with impact sensors.

C. Negative Implications

For either recommended procedure, the ability to detect, report and respond to all emergency situations in a consistent and timely manner is impossible.

If vehicles are equipped with foreign object impact sensors, impact will still occur before vehicles can be stopped. This approach only reduces prolonged dragging of an object, thus reduces the probability of death or serious damage to the system.

In a more controlled operational environment, relying upon passengers, AGT personnel or CCTV has its shortcomings. In certain situations, the above means of detecting and reporting problems is not feasible to prevent serious damage, injury or even death. The problems associated with foreign objects in the guideway is an area which will require further advances in state-of-the-art technology before this problem can be fully accommodated.

D. Cost Considerations

Unique cost considerations for recommended methods and procedures using foreign object impact detectors is the cost of the detector system. A simple detector system could consist of:

- Sensing wire and support frame on front of vehicle

- Sensing or environmental switch

- Wiring to connect switch to existing circuitry (emergency doors, etc.) for applying vehicle brakes.

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*The need to remove power will of course be dictated by the guideway/power distribution configuration of the specific system.

The other equipment needs discussed (vehicle radios, handie talkie, telephones and commands to remove guideway power, stop vehicles, or override switches) are all standard for AGT.

E. Additional Considerations

There are numerous approaches that can be used to aid in detecting foreign objects in the guideway, but only two will be discussed here. Neither is totally foolproof, but both are worthy of consideration for certain applications.

One approach deals with an impact sensor mounted on the front of each vehicle. The intent of this concept is not to prevent impact, but to detect impact and prevent prolonged pushing or dragging of the object contacted by automatically applying vehicle braking. Typically the sensing device consists of a support frame with a sensing wire which is connected to an environmental switch that is safety wired with a 15-20 lb. test line. The environmental switch in turn is electrically connected to existing circuitry (end door switch, etc.) which can apply vehicle braking when actuated.

The sensing wire is stretched across the support frame which extends some 3 or 4 feet in front of the vehicle. The height of the sensing wire is determined by the clearance envelope requirements associated with guideway grade and curves and typically may be 3 to 5 inches above the guideway. Actuation forces required to initiate the system are a function of the strength of the safety wire used to secure the environmental switch in the "Off" position. Breaking the safety wire will allow the environmental switch to trip, thus vehicle breaking is applied. The system just described is currently being used on AIRTRANS and has experienced good success in detecting luggage, construction material, rocks, animals, etc.

Another approach is to provide a special sensor system along portions of the guideway which may be vulnerable to intrusion by various large foreign objects. For example, in areas where the guideway is at or below grade (but not underground) and adjacent to a highway or street, out of control motor vehicles may penetrate normal barriers/fences and block normal AGT right-of-ways. The results can be catastrophic if not detected in a timely manner. To alert central control of this or similar occurrences, a contact sensitive wire, screen or equivalent may be necessary to help in the control of foreign objects in the guideway.

5-11. ACCOMMODATION OF LARGE CROWDS

A. Definition of the Problem

Periodically there are situations that generate abnormally high passenger demands upon a transit operation for short intervals of time. These may be associated with such events as school holidays, conventions, political rallies, sporting activities, parades, etc. In most cases, these events will be scheduled in advance, but some may occur almost spontaneously (sport rallies at airports, etc.). Frequently, only one or two stations will be affected whereas, in other situations, the entire system may be overloaded. During these peak times, minor problems tend to snowball and frequently result in abnormally long delays and utter frustration for many passengers. The following discusses possible means to accommodate this type of occurrence.

B. Recommended Method and Procedure for Accommodating Large Crowds

1. Detection and Reporting Methods

a. For Scheduled Events - Maintain a current log of future scheduled events (school or national holidays, sporting events, conventions, concerts, political rallies, etc.) that may create abnormally high transit system demands. Information sources for the log may include newspapers, radio, TV, chamber of commerce, sport schedules, etc. Knowing the time of occurrence of such events allows adequate time to prepare and implement appropriate response methods discussed later.

b. For Unscheduled Events - Any one or combination of the following:

- Monitoring station crowds via CCTV.
- Supplement the above with reports from AGT personnel regarding the occurrence of abnormally large crowds.
- Provide overload sensors on vehicles with indications at central control when crush load limits of vehicle have been exceeded.

2. Response Methods

No one specific method is recommended since several options exist and each one has certain merits depending upon each transit application and situation. Each of the following methods or design considerations should be reviewed in regard to specific needs and used accordingly:

- Add extra vehicles; run multi-car trains rather than singles.
- Store reserve vehicles in siding near high density areas for faster response time when need arises.
- Modify station dwell times as required.
- Reroute vehicles from low usage routes to high demand routes.
- Initiate express routes.
- Alter passenger flow patterns in stations if possible.
- Man stations which are most heavily affected to assist with crowd control, fare collection problems or other arising problems. Emphasize passenger safety in open platform areas. Manning requirements may typically consist of a security office and a station operations supervisor.
- Add or relocate maintenance personnel to high density area for faster response time to accommodate problem occurrences.
- Provide a backup or supplemental mode of transport to alleviate overcrowded conditions in high density usage area (reroute local buses to critical areas).
- Alert local police jurisdiction to aid in crowd control in and around parking lots and stations which are most affected.
- Sell only 2-way fare tickes for some interval of time prior to an event which is anticipated to create abnormally large crowds.* This reduces ticket demands after the event lets out and also reduces the number of fare evaders. Also, open fire emegency exits at manned stations to speed egress from stations.

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*This concept is used at PATCO with good success.

- Prior to known scheduled events, ensure that all station equipment is fully operational and has full supply of tickets, coins, etc.

- Station and vehicle announcements should be made more frequently during large crowd occurrences to inform and reassure passengers.

- Automatic vehicle coupling capability from central control to make multi-car trains from single cars.

- Walkways from stations to parking lots that minimize pedestrian and auto interactions (elevated or below grade).

C. Negative Implications

Any method used on an infrequent basis has an increased potential for human error and inefficiency. This is particularly true for unscheduled events that result in abnormally large crowds where lack of preparation time exists. Workload demands on central control personnel, security, maintenance, etc., may be excessive; therefore, individual passenger service problems may be neglected in order to accommodate the masses. Problems occurring during these crowded conditions frequently snowball or worsen because AGT personnel are spread so thin. Irrespective of the methods used to accommodate crowds, it is important to keep the people moving as safely and efficiently as possible. Extra manning of those areas which are impacted the most is normally advantageous.

D. Cost Considerations

Cost of implementing most of the suggested methods are minimal except for increased operational cost required for extra manning requirements. The suggested design considerations however, may have a substantial impact on initial design cost. These include costs for providing:

- Adequate spare vehicles to meet anticipated passenger demands

- Automatic vehicle coupling capability from central control.

- Special equipment or features to enhance passenger flow rates in and out of station and parking lot areas during high demands. (special protected walkways, extra station entrances and exits, etc.)

5-12. ACCOMMODATIONS FOR ADVERSE WEATHER

A. Definition of the Problem

Adverse weather not only has a degrading effect upon transit system operations but also can create discomfort or delays for the passenger. Snow and ice accumulations on power and signal rails and brushes, may hinder communications between vehicles and vital wayside equipment, or may cause power related problems. Futhermore, ice, snow, and rain may reduce vehicle traction on grades, causing wheel slippage and false overspeed indications that result in vehicle stoppages. Extreme temperatures may cause vehicles to stop long or short at stations; hence, normal berthing operations may be affected. High cross winds have created problems for vehicles with automatic vehicle leveling by depleting air supplies between stations thereby the leveling system becomes inadequate when needed. The above are primarily system related problems that are beyond the scope of this task. However, they have been included to create an awareness to the designer, since they indirectly impact passenger safety and service.

Of greater concern to this study are the adverse weather effects that directly impact passengers:

- Walking and waiting times associated with exposure to inclement weather
- Increased potential of falls and injuries associated with exposed walks, ramps, platforms, and open stations, in addition to wet and slippery vehicle floors.
- Passenger annoyances and delays associated with general slow down in service during adverse weather. This usually includes both slower vehicle speeds and slower response time of AGT personnel to problem occurrences.

The following considerations are provided in an attempt to better accommodate passenger needs associated with the occurrence of adverse weather.

B. Recommended Methods and Procedures for Accommodating Adverse Weather

1. Detection and Reporting Methods

a. The occurrence of pending adverse weather is generally common knowledge to all transit personnel through a variety of media sources (radio, TV, newspapers, etc.). However, more specific details related to arrival times of weather, predicted severity or accumulations, etc. are vital to transit operations. Provided with proper warning, preventive or preparatory measures can be made to lessen the resulting impact on passenger safety and service. The following considerations are provided in an attempt to detect the occurrence, severity and impact of adverse weather.

(1) Provide central control with a readily available source of weather information:

- Pending changes in weather
- Predicted arrival times and duration of adverse weather
- Predicted severity or accumulations anticipated.

(2) Possible sources for this information include:

- Local branch of national weather service*
- Weather information available at local airports
- Providing a simple weather station at central control if other sources are not geographically applicable to the immediate location.
- Hiring a local weather consultant.

(3) The actual impact that weather has on the system may require even further inputs from:

- AGT personnel in the system
- Station CCTV with visual access to outdoors
- Outside visual access provided by windows at central control.

2. Response Methods

No specific recommended method and procedure is provided. Instead, a variety of considerations, both design and operational, have been provided and should be used as required or applicable to individual sites and needs.

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*Some past experience indicates that national weather service information may not be localized enough and in some cases is too cautious.

- Enclosed stations are highly preferable to open stations and platforms, particularly for northern site locations.

- If open stations are provided, consider the use of wind breakers and special radiant heaters, etc. during extreme cold conditions.

- Minimize "wait times" in open stations if possible. During severe weather, give special attention to open stations and make every attempt to maintain prompt service to the unprotected user. Response times of dispatched AGT personnel to problem occurrences affecting open stations should be more prompt than normal, if possible.

- Minimize the walking distances from parking lots to stations.

- Stairways, ramps and escalators leading in and out of stations should be covered because of the high injury rates associated with these areas. If covering is not practical, heating walking surfaces or the use of non-slip material should be considered. This is also true for platform and boarding areas in open stations.

- When establishing the need for hand and guard rails, consider the effects of adverse weather in unprotected areas.

- Slip resistant floor materials should be used in vehicles to reduce potential for falls. Tracked-in snow, ice and moisture coupled with normal vehicle movement will increase threat of falls.

- Snow and ice removal by shoveling from platforms, stairs, etc., is preferred over the use of sanding and salt. Excessive use of sand or salt fouls door and escalator operations, increases carpet or floor wear and increases the need for station and vehicle cleaning.

- Provide proper drainage for walkways and guideway to accommodate heavy rain or melting snow.

- Consider special brochures (to be used when transit service has been terminated due to adverse weather), to aid passengers in making connections for other modes of transportation.

- The design of the guideway should prevent snow accumulations in/on the running surfaces and power/signal rails. Preventative measures against blowing/drifting snow should also be considered. Sanding and particularly salting of the guideway is generally not recommended because of corrosion and increased wear on brush assemblies, guidewheels and associated equipment.

- Heated power and signal rails, vehicle brush assemblies or equivalent may be necessary in operating environments which experience heavy snow/icing conditions. For less severe operational sites, shelters over certain guideway sections (inclines) may be required.

- During snow and icing conditions, spare vehicles should be stored in protected areas or put into service to prevent "freeze-up" if possible.

- With the occurrence of vehicle wheel slippage on grades, initiating "slow speed overrides" on appropriate sections of the guideway may help to reduce the problem.*

C. Negative Implications

Since specific recommended methods and procedures were not provided for this problem area, negative implications will not be addressed. For some of the design and operational considerations provided, various preferences and less desirable features were stated in appropriate cases.

D. Cost Considerations

Many of the design considerations provided (enclosed stations versus open, heated or protected guideways, etc.) will have a substantial impact on initial design cost. Since these needs are location and size sensitive, and configurations may vary substantially from one application to another, it is impractical to address realistic cost factors.

E. New and Untried Methods

None.

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*This approach has proven beneficial on AIRTRANS during inclement weather.

5-13. FIRE AND SMOKE DETECTION

A. Definition of the Problem

Fire and smoke occurrences in transit systems are typically infrequent; however, they present a potentially hazardous situation to both passengers and equipment. The circumstances surrounding this type of emergency is usually panic and uncertainty. The next section (5-14) addresses passenger reassurance associated with emergency situations (which include fires). Because of the similarities associated with methods and procedures for fire occurrences and passenger reassurance during emergencies, reference is made to the Section 5-14. Considerations related to the occurrence of fire should therefore include the information provided in this section as well as the applicable information in Section 5-14.

B. Recommended Methods and Procedures for Fire and Smoke

1. Detection and Reporting Methods

- Rely upon sensors* with alarms and indications at central control for detection of fire/smoke. The following applications should be considered:
  - Passenger stations
  - Tunnels
  - Equipment bays and other high risk areas
  - Vehicles**
- CCTV should be used to verify sensor reported occurrences and to determine the severity of smoke and fire occurrences in stations.
- For low risk areas, along guideway or where sensors or CCTV coverage are not applicable, rely upon AGT personnel in the system or passengers for detection.
- For some applications, such as at airports, etc., it is desirable to have fire/smoke alarm indications at the airport fire department as well as at central control.

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* Sensors should prioritize smoke detection since a lethal amount of smoke can be generated long before flames are detectable.

**If used, vehicle sensors should be capable of distinguishing between overheat conditions and actual fire occurrences since the response methods will differ for each.

2. Response Methods

Response methods for fire and smoke occurrences on vehicles and in stations are provided in Chapter 5-14, paragraph B.

C. Negative Implications

- Possibility of false alarms
- Inability to readily detect fires in low risk areas, where sensors or CCTV coverage are not realistic.

D. Cost Considerations

Cost impact for accommodating the recommended method and procedure are minimal. The required fire sensors for stations, tunnels and equipment bays are typical for AGT. Fire sensor on vehicles are an exception since they are not commonly used in transit applications. The need for vehicle fire sensors, however, does seem justified since the vehicle presents a moderate to high risk area.

Other equipment needs such as radio and PA communications, switch, vehicle and guideway power commands are also typical of AGT.

E. New and Untried Methods

None.

5-14. PROVIDING PASSENGER ASSURANCE DURING DELAYS AND EMERGENCIES

A. Definition of the Problem

Passenger reassurance during service delays and/or emergency situations requires attention in two distinct areas, (1) those passengers awaiting service in stations and (2) those passengers onboard affected vehicles. Station related emergencies such as fires, or delays associated with service interruptions, typically present situations that are less hazardous than similar events occurring onboard vehicles. In station related fires or emergencies, egress pathways are usually more numerous and present fewer hazards to fleeing passengers. For impatient passengers awaiting a vehicle in a station during service delays, he or she is reasonably confined in a relatively safe environment. If the same type of emergency or delay occurs onboard a vehicle, the results could potentially be more hazardous. Smoke or minor fires or service delays may cause panicked or impatient passengers to make uncontrolled exits from the vehicle. Uncontrolled exits may in many cases subject the passenger to a more hazardous situation than staying onboard the vehicle. These hazards include such things as passengers falling from the vehicle or guideway, contacting power rails, or being struck by another moving vehicle. In addition, uncontrolled vehicle evacuations prolong minor service delays substantially because power has to be removed from the guideway.

Therefore, the real need for passenger reassurance becomes most critical for vehicle-related incidents, rather than station occurrences. These needs are twofold:

1. Providing instructions to passengers during onboard emergencies requiring immediate evacuation (fire/smoke).

2. Preventing uncontrolled vehicle evacuation during minor service delays when there is no need to abandon the vehicle.

B. Recommended Method and Procedure for Providing Passenger Reassurance

1. Detection and Reporting Methods

Means of detecting the need for providing passenger assurance are manifold and central control personnel should be well aware of occurrences that will dictate the need. This information is readily available through an assortment of system related sensors, smoke/fire detectors, CCTV and to some degree, inputs from other AGT personnel or passengers. Categorically, there are two general occurrences that may establish the need for passenger reassurance:

a. Any emergency which presents a potentially hazardous situation to the passenger; e.g., fire/smoke in a station or vehicle, vehicle collision, impacting foreign object in the guideway, etc.

b. Any occurrence that results in vehicle queues; thereby causing a delay in service; i.e., malfunctioning vehicles, switches and doors, power outages, etc. Delays of 5 to 10 minutes will typically be tolerated by vehicle passengers, but much more than that increases the potential for abandoning the vehicle. Vehicle passengers will typically flood central control with numerous radio inquiries during these delays unless reassurance announcements are provided promptly and on a regular basis. Restless station passengers affected by the delay can, of course, be detected by CCTV, and by telephone reports to central control.

2. Response Methods

a. For Emergencies Onboard Vehicles (with ongoing threat)

NOTE: It is recommended that vehicle doors be provided with an interlock so that during onboard emergencies, attempts to open the doors on a moving vehicle would stop the vehicle first, then allow the door to open.

Upon receipt/detection of vehicle emergency situation (fire, smoke, toxic fumes):

- If travel time to the next station and the severity of the ongoing threat are known to be minimal, it is desirable to get the affected vehicle to the closest station for evacuation.

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*For some configurations of AGT systems (suspended tramway), the need for some effective method of fire extinguishment onboard the vehicle may be necessary.

This of course may be influenced by several factors. In some systems it may be undesirable to bring a vehicle that is on fire into a station area especially if the vehicle could be safely evacuated in the guideway. However, for monorail or suspended tramway systems, where evacuation outside of the station area is practically impossible, it may be more expedient and less hazardous to bring the vehicle into the station. If evacuation in the guideway is required:

- Remove power to affected portion of guideway and dispatch AGT personnel (security, fire, medical and maintenance personnel).
- Via vehicle radio, address affected vehicle and provide instructions for evacuating the vehicle*.
- Divert other vehicles away from problem areas as required and initiate door hold commands for stations up stream of problem.
- Address other station and vehicle passengers that may be affected by service interruption.
- Fire and maintenance personnel shall extinguish fire. Security should assist passenger evacuation and medical personnel should provide first aid as required.
- After fire is extinguished, maintenance personnel should assess damages and need for tug operations or backup mode of transportation and respond accordingly.
- Remove affected vehicle from service; verify guideway is clear; restore power and resume normal service.

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* In situations where "overheat conditions" are detected onboard a vehicle, rerouting the vehicle to the nearest station may be safer than evacuating passengers into the guideway.

b. For Station Emergencies

Upon receipt and detection of station related emergencies (fire/smoke or toxic fumes, etc.)

- Attempt to verify severity of problem on CCTV and dispatch AGT personnel (fire, security, medical, maintenance) to affected station as required.
- Instruct station passengers via PA on evacuation procedures.
- By use of available remote control features, release or unlock fire gates, turnstile or other special exits that may aid emergency egress. If normal exits are impassible, it may be necessary to remove power from the guideway and allow passengers to evacuate into the guideway only as a last resort.
- Divert other vehicles away from affected station and initiate door hold commands on stations upstream from the affected station as required.
- Dispatched personnel should extinguish fire or correct problem and provide required assistance or aid to passengers.
- Assess damage and determine if service can be restored or station should be closed.
- Make appropriate announcements to other vehicle and station passengers that may be affected by the delay or closing of the station.

c. For Service Delays Affecting Vehicle Passengers

Upon receipt of any malfunction or any other occurrence which may cause vehicle queues between stations, the following steps should be initiated to prevent passengers from abandoning vehicles:

- Dispatch maintenance to affected vehicle(s) and immediately address stopped vehicle(s) via vehicle radio. Inform passengers that:

  - Central Control is aware of the stopped vehicle
  - Assistance has been dispatched
  - Passengers should remain onboard the vehicle for their own safety.
- As other vehicles queue up behind the problem, repeat reassurance announcements to each affected vehicle.
- If service delay to stations downstream of problem is anticipated to be more than 5 minutes, make appropriate PA announcements to affected stations.
- If problem persists, alert tug operators, evacuation and rescue personnel and repeat reassurance announcements to affected vehicles and stations.
- If problem resolution is not anticipated within 20 to 30 minutes, initiate backup service (buses or equivalent) and commence to evacuate vehicles. Every effort should be made to get the affected vehicles to stations to deboard passengers in the safe confines of a station if possible.
- Make all vehicle and all station announcements that service is being terminated. Advise vehicle passengers to remain onboard vehicles until AGT personnel can get the vehicles to the next station or provide assistance in evacuating the vehicles. Advise station passengers of alternate modes of transportation that are available.

C. Negative Implications

Passenger reassurance announcements may not be totally adequate to prevent some irate passengers from making uncontrolled vehicle evacuations.

With multiple problem occurrences, work load demands at central control and radio traffic required to correct problem may cause passenger reassurance announcements to be made too infrequently.

D. Cost Considerations

There are no unique costs associated with the recommended methods and procedures. Required communication systems, sensors and remote command features are typical of AGT.

E. New and Untried Methods

- Automatic Passenger Reassurance announcements for service delays

  Consider the use of automatic passenger reassurance announcements onboard vehicles. Standard taped recordings, similar to automatic onboard destination announcements that are currently being used, could be automatically initiated when a vehicle has experienced an unscheduled delay of more than 2 or 3 minutes. The unit would be self-contained on each vehicle and would not tie up vital radio channels which typically become over loaded when coordinating corrective action for problem occurrences. Under stressful situations, workload demands on central control personnel are reduced and the human error element of saying the wrong thing is also eliminated. The obvious disadvantage of this concept is the lack of "personal contact" which is a common complaint of automated system.

CHAPTER 6.
EQUIPMENT AND PERSONNEL CONSIDERATIONS FOR PASSENGER SAFETY AND CONVENIENCE SERVICES

A. General

This section addresses equipment and personnel needs related to the detection and resolution of AGT passenger safety and convenience service (PS&CS) problems. Because most equipment and AGT personnel serve multiple roles in accommodating passenger problems, their functions will be addressed in two separate categories:

- Equipment and personnel needs for basic detection and reporting methods
- Equipment and personnel needs for basic response methods

B. Equipment and Personnel Needs for Basic Detection and Reporting Methods

As defined earlier, there are four basic detection methods:

- CCTV
- Special sensors
- Passengers
- AGT personnel

The following paragraphs provide details related to specific equipment or personnel capabilities and applications.

1. Closed Circuit Television (CCTV)

a. Station Application

In an AGT system, CCTV provides significant means by which central control supplements its detection capability with the absence of vehicle and station personnel. CCTV functions are many fold, both from the PS&CS point of view as well as overall system operations.

In current transit operations, both conventional and AGT, CCTV has been limited primarily to station applications. Table 6-1 provides a summary of a few transit properties using CCTV and its utilization.

Although the initial cost of CCTV in stations is significant, the savings can become substantial in a short period of time. Properly installed, CCTV reduces station manning requirements, provides visual information that is not readily obtainable by any other means, and may reduce the need for some station sensors. Rather than installing separate sensor (with central control readouts) for turnstiles, fare issuing equipment, change machines, add-a-fare equipment, a properly installed CCTV system can reduce the need for dedicated sensors. In some cases, individual equipment sensors may still be required but the associated indicator light may be mounted in the station and viewed on CCTV rather than transmitting it to central control. One major drawback to CCTV is the requirement for continuous monitoring of the TV displays. Because of the continuous monitoring requirement, CCTV is not recommended for potentially hazardous problems such as detecting fire and smoke and unscheduled door openings. For these occurrences, sensors with indicators and alarms at central control are recommended since they provide rapid detection and automatic reporting.

CCTV may provide several other functions that will not be discussed in detail here. These are summarized in Table 6-2 and include potential CCTV functions for stations, vehicles and guideway applications.

b. Vehicle Applications

Although CCTV* onboard vehicles is not currently being used in the transit industry, it is being investigated on an AGT test vehicle at the Dallas/Fort Worth Airport. Cost and picture quality appear to be two limiting factors at present. Assuming that these problems are overcome in the near future, vehicle CCTV should prove to be a major step towards replacing the conventional onboard operator and provide improved detection capabilities in future AGT systems. Potential users for vehicle CCTV are included in Table 6-2.

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*More technically referred to as narrowband TV for onboard vehicle applications.

TABLE 6-1. EXAMPLE OF SOME CCTV APPLICATIONS IN EXISTING SYSTEMS (AGT AND CONVENTIONAL)

SYSTEM	TOTAL NO. OF CAMERAS	TOTAL NO. OF MONITORS	LOCATION OF CAMERAS	LOCATION OF MONITORS	PRIMARY PURPOSE	CAMERA CONTROL FEATURES	NO. OF OPERATORS REQD. TO MONITOR
AIRTRANS (AGT)	28	2	1 per pass. sta. (14) 1 per employee sta.(14)	Central Control	Monitor station crowds, station doors, turnstiles, etc.	Pan in pass. sta. Fixed in employee sta.	1 at Central Control
MPM-MORGANTOWN (AGT)	16 **	16 **	4/sta. platform (2 sta. with 1 platform=8) (1 sta. with 2 platform=8)	Central Control	Monitor loading platform and AFC.	Fixed	1 at Central Control
SEATAC (ACT)	16	16	2 per station	Central Control	Crowds, security & door operations	Fixed	1 at Central Control
PATCO*	21-24	12-13	1/fare area 1 on some platforms	Central Control	Monitor AFC & security	Fixed	3 at Central Control
BART*	4/sta. (typical)	8 (split screen)	1/elevator escalator fare gates	Central Control	General Remote Monitoring of Stations	Sequence	1 operator/ 4 stations

*Denotes conventional transit systems.

**During Phase II expansion at Morgantown (1979), the number of CCTV monitors and cameras will increase to 32 each.

TABLE 6-2. POSSIBLE FUNCTION ASSOCIATED WITH CCTV

DETECTION AND MONITORING FUNCTION	CCTV LOCATIONS		
	IN STATIONS	ON VEHICLES*	ALONG GUIDEWAY ON ADJACENT PROPERTY OR PARKING LOT
Monitor passenger crowds	X	X	X
Reassurance to passenger that he is being "watched after" during delays and emergencies	X	X	X
Crime & vandalism deterrent	X	X	X
- Stealing money from equipment			
- Vandalism			
- Criminal acts against passengers			
Smoke/fire detection	X	X	X
Detection of lost, confused, ill or injured passengers	X	X	
Monitor dynamic graphics in station and vehicles	X	X	
Monitor vehicle/station door alignment (vehicle stop profiles)	X	X	
Monitor routine door operations	X	X	
Monitor unscheduled door operations	X	X	
Detect door holding by passengers	X	X	
Monitor station platforms	X		

* When State of the Art Allows

TABLE 6-2. POSSIBLE FUNCTIONAL ASSOCIATED WITH CCTV (CONTINUED)

DETECTION AND MONITORING FUNCTION	CCTV LOCATIONS		
	IN STATIONS	ON VEHICLES*	ALONG GUIDEWAY ON ADJACENT PROPERTY OR PARKING LOT
Monitor fare equipment (turnstiles, ticketing equipment, change machines, etc.)	X		
Monitor vertical movement (stairs, escalators, elevators, etc.)	X		
Detection of soiled stations, vehicles	X	X	
Detection of loss of lighting	X	X	
Central Control reassurance during delays and emergencies	X	X	X
Monitor special gates to allow employee and E&H access	X		X
Verify vehicles are empty before removing from service or rerouting	X	X	
Detection of foreign objects	X	X	X
Monitor critical switch areas			X
Monitor evacuation and rescue operations	X	X	X
Verify vehicle identification	X	X	X
Monitor weather conditions	X	X	X
Monitor parking lots			X
Monitor station access areas	X		X

* When State of the Art allows

c. Number and Location of CCTV Cameras

The specific number of CCTV cameras and their locations for station application depends upon several factors. These factors include:

- Station size and arrangement
- Primary and secondary functional intent of CCTV installation; be it a crime and vandalism deterrent, safety monitoring of platform, monitoring turnstiles or automatic fare collection (AFC) equipment, etc.
- Control features and field of view of camera (pan, zoom, stop, start, etc.)
- Complexity of station-related equipment (simple turnstiles vs. complex AFC system)

Irrespective of station size and arrangement, equipment used, or intended function, each CCTV installation should be assessed against the following factors, as dictated by the specific application.

Ability to Monitor or Observe:

- Platform adjacent to guideway in an open station with respect to passenger safety
- Station boarding doors and emergency station doors in a closed station
- Manual turnstiles or automatic fare collection system including fare issuing equipment, add-a-fare, change makers, etc. (also as deterrent to vandalizing equipment or fare evasions)
- Special access gates used by employees or elderly and handicapped (E&H)
- Elevator doors for applications where elevators are restricted for use only by E&H
- Restroom doors where situations dictate the need for controlled restroom access
- Stairways and escalators because of the high frequency of accidents that occur on vertical access areas. Also to monitor escalator status - operating or stopped

- Overall station area to observe station crowds, or means to deter and detect crime and vandalism
- Dynamic graphics above boarding doors
- Vehicle stopping and berthing profiles at station platform or doors (be able to detect if vehicles are stopping long or short).

d. Number of Monitors at Central Control

The number of CCTV monitors required at central control to view the CCTV cameras in an AGT system may vary considerably depending upon the size and complexity of the system (number of stations and cameras) and the primary functions for which the CCTV system is installed. For example, in a system with open station platforms, one of the most critical functions for CCTV may well be a safety consideration; i. e., monitoring the platform adjacent to the guideway in the station. For systems located in a "hard to control environment," where crime and vandalism may be a major problem, constant monitoring of station areas may be necessary to aid in crime reduction. Furthermore, current systems using AFC system and no station attendants have found that CCTV is a must for monitoring AFC operations. For all of the above examples, the need for constant surveillance of each station becomes a necessity. Each camera covering an area requiring constant surveillance will require a separate monitor at central control. Some current operational systems have up to twenty-four monitors at central control and require up to three people to constantly monitor TV displays and handle the related communications required. During non-peak time, only one person is required, assuming he is relieved from his monitoring duties on a regular basis. This brings up the question of, "How many monitors and for what period of time can an individual monitor TV displays effectively?" This is a complex question with no simple solution. Studies by Tichener and Poulton[1] investigated the problems associated with monitoring numerous TV displays. In these two studies, up to twenty-four TV displays were monitored for one hour to determine detection rates. One study was concerned with screen presentation with "little movement," while the other presentation depicted a "great deal of movement." The following information is provided based upon the result of these studies:

- If 100% detection is required, one person per monitor is required.
- Sixteen monitors with "a great deal of movement" had a detection percentage of 64% which is unacceptable. Nine monitors yield an 83% detection rate and four monitors an 84% rate; hence, there is no advantage in reducing the number of monitors from 9 to 4.

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[1] Tichener, A. H. and Poulton, C. E., Monitoring Up to 16 TV Pictures Showing a Great Deal of Movement, Ergonomics, Vol. 16, No. 4, July 1973, pp. 381-408.

- For monitors with "little movement," detection rates were:

  24 monitors = 88% detection

  16 monitors = 97% detection

  Sixteen is recommended as the maximum number of monitors to observe when "little movement" is involved.

- When observing 8 monitors with a great deal of movement, a maximum viewing time of 1 hour is desirable. Two hours is certainly too long; whereas, 1/2 hour has no advantage over 1 hour.

- Large displays (40 x 30 cm) provide a higher detection rate than small displays (20 x 15 cm). Positioning the observer at half the large display viewing distance from the small display did not fully compensate for the reduction in display size.

- A viewing distance of 3 meters appears to be about the optimum for 16 larger displays (40 x 30 cm).

The above conclusions should not be construed as firm requirements for an AGT application since they are based on monitoring tasks associated with prison applications. It is suggested that a detailed review of these studies be conducted to determine applicability to specific transit applications.

In addition to the above study data, the following information is provided related to actual CCTV usage in current transit operations.

Morgantown uses 16 CCTV displays at central control which are monitored primarily by one operator, but may be assisted by a supervisor as required. On a rather informal basis, the CCTV observer will rotate work positions with the two other operators. In general, their experience reflects the need for rotating position approximately every two hours. The CCTV system is used primarily as a safety feature to detect people or animals in the guideway in the station platform area. Other functions include monitoring the AFC system, station crowds, and operational events, such as stopping profiles, door operations, etc. In addition, the CCTV observer has other communication-related functions which include PA, radio and telephone communications. Morgantown personnel feel that one observer can satisfactorily handle the required detection tasks for which the CCTV system was intended.

During Phase II expansion of Morgantown (1979), the number of monitors will be increased to thirty-two.

In other transit applications, such as airports or amusement parks, in which there is a very controlled environment, the functions served by a CCTV system may be considerably different. These systems may typically have closed stations, simple manual turnstiles or none at all, and crime and vandalism is essentially non-existent. For this type of application, CCTV is used to monitor station crowds, vehicle and station door operations, etc. Since constant monitoring of each station is not as critical, it becomes feasible to reduce the ratio of monitors to cameras. In other words, two monitors at central control may be adequate to cover 24 to 28 cameras. Viewing can be achieved on one monitor by use of an automatic sequencing feature that will step through the various cameras located throughout the system. The other monitor is used to display any camera location which the operator desires to select manually. Dwell times for an automatic sequencing feature should be variable by software changes depending upon specific needs. A "fast" and "slow" sequence capability should be available to the operator. The ability to reverse the sequence should also be provided. An automatic feature should also be provided that would interrupt the normal sequencing mode and "sequence to" and "lock on" the camera where a "station malfunction" or a "vehicle malfunction in a station" has occurred.

The system just described is essentially that being used on AIRTRANS and has proven successful for its intended purpose. Only one person is required to view the two monitors which sequence thru the 28 camera installations.

2. Special Detection Sensors

In AGT systems, the need for more dedicated sensors for status and malfunction detection becomes evident. Even in newer conventional systems, the use of special sensors is becoming more widespread. In conventional transit applications, most of the sensor information is conveyed or displayed in the vehicle operator's compartment or in the station attendant's booth. In an AGT environment, this sensor information will have to be conveyed and displayed at central control. The following provides a summary of some typical detection sensors which should be considered for AGT applications. Not all the sensors listed are directly related to PS&CS but indirectly have an effect on overall system operations; consequently, service and safety of passengers can be influenced. Sensors offer the advantage of providing very fast, around-the-clock, detection and reporting capabilities for relatively low cost. Because of this, sensors are recommended for problem occurrences that are potentially hazardous to passenger safety or may have a substantial impact on passenger service. Two obvious examples of this include the detection of smoke/fire and unscheduled vehicle or station boarding or emergency door openings.

The following are typical sensor applications and should be considered as dictated by specific system needs.

a. Station Related Status/Malfunction Sensors and Indications

- Turnstiles - sensor and indication to denote malfunctioning turnstiles; e.g., frozen, free wheeling, will not accept cards or coins, etc.
- Ticketing Equipment - sensor and indication to denote low supply of tickets remaining or malfunctioning equipment
- Change Machine - sensor and indication to denote low supply of change or equipment malfunction
- Elevators/Escalators - sensor and indication to denote stopped or malfunctioning escalator or elevator
- Graphics - sensor and indication to denote inoperative or incorrect graphics presentation
- Station Doors* - sensor and indication to denote any of the following:
  - doors fail to open as scheduled
  - doors held open after close command
  - doors not closed and locked after close cycle complete

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* Denotes sensors which are highly recommended.

. Station Doors* (Cont)	. unauthorized opening of station doors . door touchstrip malfunction
. Vehicle* Malfunctions Occurring in Stations	- sensors and indication to denote any of the following: . failure to berth . vehicle cannot depart station . vehicle has reberthed . vehicle has overshot station . vehicle door does not open
. Smoke/Fire Sensors*	- Typically located in station areas, tunnels, equipment rooms and in some cases, onboard vehicles May be supplemented by automatic sprinklers or fire extinguishing system. Associated alarms are received at central control and in some cases, at local or adjacent fire departments.

With the occurrence of any of the above station-related malfunctions, a Master Station Malfunction Indication for that station should be received at central control. Details related to the specific type of malfunction that has occurred should be provided on a CRT display or equivalent readout. For systems using an automatic CCTV sequencing system (using two or three monitors at central control to view several CCTV cameras), it is also recommended that the appropriate CCTV camera(s) for that station be automatically displayed on one of the monitors with the occurrence of any station malfunction.

b. Vehicle Related Status/Malfunction Sensors and Indications

. Doors*	- sensor and indication to denote any unscheduled door openings for normal boarding and emergency doors.

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*Denotes sensors which are highly recommended.

- Graphics - sensor and indication to denote inoperative dynamic graphic onboard the vehicle (if used)
- Automatic Onboard Announcements - sensor and indication to denote inoperative automatic announcement for destination or arrival information
- Air Conditioning - Ventilation - Heating - sensor and indication to denote inoperative environmental control system
- Vehicle Overload - sensor and indication to denote that weight capacity of vehicle has been exceeded
- Foreign Objects - sensor and indication to denote that a foreign object has been detected or impacted in the guideway, if applicable
- Communications - sensor and indication to denote that a vehicle passenger has initiated a request to communicate with central control

These do not include all vehicle related malfunctions which are typical of AGT but only those which are most directly related to passenger safety or service. Malfunctions such as low air pressure, overspeeds, route errors, propulsion motor failures, etc., have not been included.

Indications received at central control to denote any of the vehicle-related problem occurrences should provide the following information:

- The indicator light on the guideway schematic that represents the affected vehicle should change colors (green to red) and should flash until acknowledged by central control.

- On a vehicle status panel, CRT display or equivalent, the following details should be provided:

  - Identification number of affected vehicle

  - Block number or location of affected vehicle

  - Type or class of malfunction and specific details of problem

3. Passengers as Detectors and Reporters

Passengers in current transit operations (both conventional and AGT) frequently serve as a means of detecting and reporting a variety of problems. Typically, they will report those problems which directly effect their well being and not system-related problems. However, to rely upon passengers as a reliable and sole means of detecting and reporting problems in an AGT environment is unrealistic. Frequently, passengers do not have the knowledge, time or desire to become involved. In other instances, well-intentioned passengers may provide information or assistance which may further compound or confuse the problem. Furthermore, the absence of passengers in a system late at night creates a void in the detection process. Other advantages and disadvantages of passengers as a detection source were discussed earlier in Chapter 4.

It is safe to assume that passengers will continue to detect and report certain types of problems in AGT. Their participation should be encouraged since they offer an inexpensive method of detection and reporting. For situations where passengers are lost or confused, or separated from their children, or have lost some article, etc., it can be assumed that the affected passenger will report these occurrences. For system-related problems (e.g., inoperative equipment, soiled vehicles, etc.), the probability of passenger reporting will decrease. The frequency or efficiency by which passengers report problems is not predictable but may well hinge around the availability and ease of use of passenger to central control communications. Station telephones and vehicle radios provide the primary link between the passenger and central control. In future AGT systems, this link must be improved over that presently used in conventional transit systems.

The following considerations are directed toward improving the passenger-central control communications link. They include both communication issues as well as other methods that will enhance the use of passengers as a source for detecting and reporting problems. More specific communication needs are discussed later in this section.

- Readily available courtesy telephones in all station areas or other applicable locations that are accessible to all users; i.e., elderly, handicapped, children, etc. Drop lines which require no dialing are most desirable. Phones should also be accessible from either side of turnstile entries.

- Readily available, easy to operate two-way radio voice communications between all vehicles and central control. The use of duplex systems are prefered over simplex systems.

- Ability for passengers to readily identify AGT personnel through the use of standard uniforms or identification worn by all transit personnel.

- Public relations campaigns and educational programs to encourage passengers to take pride in and use "their transit system."

The Toronto Transit Commission has for several years given special lectures to grade school age children in regard to the "use" and "abuse" of the Toronto Subway System. Children are instructed on how to use the system - not to abuse it. Emphasis is placed on the concept that the system belongs to the people and that the people should take an active role in preserving the system. Incidents and problem areas should be reported by passengers if observed. This concept has given numerous indications of being a very successful and cost effective effort.

4. AGT Personnel as Detectors

In most conventional transit systems, the majority of passenger safety and convenience service problems are currently being detected and resolved by vehicle operators and station attendants. Other transit personnel such as security, maintenance, supervisors and janitorial will periodically detect and resolve some problem occurrences as they rove the system. Most carry radios and can be easily dispatched to problem areas. Other properties position personnel at strategic locations throughout the system and central control will dispatch them as required.

With the absence of onboard operator and station attendants in AGT systems, the roles and duties of the specialist groups mentioned above become more important. Whether these specialists are positioned at fixed operational locations or roving the system, they will have to help fill the void created by the absence of vehicle and station personnel for detecting and rectifying problems.

In order to utilize AGT personnel more effectively in the detection and response aspects of PS&CS related problems, the following considerations should be assessed with respect to future AGT systems.

- For large and widespread systems, consider the use of "roving" maintenance personnel rather than locating them at one central maintenance facility. The rovers not only detect and resolve potential problems before they occur, but are usually able to respond faster to problems once they have occurred.

- All AGT personnel, whether maintenance, security, supervision, janitorial, etc., should be well trained and versatile in a variety of operations-related tasks. For example, all should be trained in first aid, all should be generally knowledgeable of entire system and policy related to passenger problem. Even janitorial personnel should be active in the process of detecting and reporting problems.

- Hiring policies for AGT systems should consider personnel with bilingual capabilities for sites where there may be a large multilingual or foreign user population.

C. Equipment and Personnel Needs for Basic Response Methods

The following pages summarize the equipment and personnel needs associated with each of the four basic response methods:

- Instructions via communications (telephone, radio, or PA)
- Dispatching personnel (AGT or others)
- Exercising remote control features
- Altering systems operations

1. Instructions via Communications

For non hazardous problem occurrences (lost or confused, aid to illiterate, passenger reassurance, etc.) providing instructions or directions via station courtesy telephones, vehicle radios and PA are desirable response methods. These forms of communications provided a fast and reliable means of addressing system wide problems and reduce the need to dispatch AGT personnel to many problem occurrences.

The following categories of communication needs will be dis-discussed:

- Vehicle Voice Communications (Radio and PA)
- Station Related Communications (Telephones and PA)
- Other Communications Needs

a. Vehicle Voice Communications

Two-way voice communications between each vehicle and central control is a firm requirement for AGT. The communication system should allow passengers to initiate a request to central control for 2 way communication and it should also allow central control to initiate 2 way radio communication with any one vehicle or PA communications with all vehicles at once. The following considerations are also provided:

- Duplex radio communication systems are preferable to simplex systems. Simplex systems require push-to-talk and release-to-listen feature. Passengers frequently will not release the talk button, hence, central control cannot respond to passenger request.

- Controls used by passengers onboard vehicles to initiate communication request should be readily accessible to all passengers, including wheelchair users and small children. It should be designed and located to preclude inadvertent operation and isolated from door hold buttons, etc. Touch sensitive stripes, which transverse the entire vehicle interior, are not recommended, as a means of initiating a request for 2 way communication. The relative distances between the speaker/microphone and touch sensitive stripe may preclude audible communications.

- In some cases, it may be desirable for central control to address only one vehicle in a multi-vehicle train.

- Central control shall automatically be provided with the vehicle identification number and location of any vehicle requesting 2 way voice communications.

- Simultaneous commands for train control and communications systems shall be possible for central control operators. For example, central control operator A should be able to issue a train command (stop vehicle No. XX) and operator B should be able to select and address another vehicle via radio simultaneously.

- A vehicle from which a request for 2 way communications has originated, shall not depart the next station, until the "Communication Request" has been acknowledged and reset from Central Control. This is to ensure that all communication requests from vehicles are not overlooked by central control and that any problem onboard will be reported before leaving the next station.

b. Station Related Communication

Communication needs associated with station areas fall into 2 categories:

- Telephone communication
- PA communication

1) Telephone Communications

As a minimum, two way telephone communication shall be provided between each station and central control. Drop lines, requiring no dialing, with locations which are accessible from either side of the turnstiles are preferable. Calls initiated from station courtesy telephones should automatically inform central control of the station from which the call originated. For small systems, the above may be the only telephone needs for station applications. For larger systems, the need for public telephones should also be considered. It is recommended that the two are not combined. Heavy public telephone usage may preclude telephone access to central control when an emergency arises if both communication systems are combined. Requirements for public telephones are provided below:

> Public Telephones: Public phones should be housed in alcoves or separated by partitions; booths with doors should be avoided. Phones may be accompanied by folding seats. Coin slots, receiver cradles, and dials should be no higher than 48 in. from the floor to accommodate wheelchair passengers. Push-buttons with raised numbers and letters should be used instead of dials to aid the blind. At least one public telephone in each terminal should have a selection switch to increase the volume of transmission for those with hearing disabilities. An appropriate sign should be used to designate this phone.

2) PA Communications

One way voice communications (PA) from central control to all stations is a firm requirement for AGT. Central control shall have the ability to select any one, or any combination, or all stations PA's.

The primary use of PA is in response to the occurrence of problems, i.e., announcing delays, provide passenger reassurance, etc. Rarely are they used routinely during normal operations. This is not to say that announcements should not be used routinely to supplement station destination graphics. Supplementing visual destination information with verbal information is desirable but it should not be a routine function performed by central control personnel. The use of automatic taped announcements in stations and aboard vehicle are much preferred.

More typically, the usage of PA announcements include:

- Providing passenger reassurance during delays or emergencies.
- Providing destination information to passenger when graphics or automatic announcements have failed.

- Advising passengers that service is being terminated due to system problems or at the end of the service day.

- Aiding in locating separate passengers, i.e., make all train and station PA announcements and advise lost party to contact central control.

- General paging of passengers or AGT personnel.

- Advising passengers with problems to go to the courtesy phone and call central for assistance (problems being detected via CCTV).

- Issuing warnings to turnstile jumpers or other system offenders who are detected on CCTV.

- Advising station passenger to "not board" next arriving vehicle because it is being removed from service.

Traditionally there have been two rather common problems associated with the use of PA. First, PA announcements in stations are of traditionally poor quality or inaudible. Poor PA systems design, accoustical characteristics of stations, background noise from passengers and vehicles, and enunciation of addressing personnel are usually responsible for this shortcoming. There appears to be much room for improvement in this area. The second problem is workload demands on central control personnel. During delays or emergencies, when the need for passenger reassurance announcements becomes more critical, other more pressing demands makes it difficult to adequately perform this function. Adding extra personnel to cope with these infrequent occurrences usually results in boredom during normal or routine operations.

c. Other Communication Needs

In addition to passenger related communications, there are other communications needs which are vital for safe and efficient operations in AGT. These include means by which central control dispatches and coordinates various AGT personnel or other special agencies which are instrumental in accommodating problem occurrences. In most cases, it is the AGT maintenance personnel who serve the key role in resolving most daily occurrences that require the dispatch of personnel. Therefore, the central control to maintenance communications link becomes crucial to ensure this vital role. Two-way voice communication between the following should be provided:

- Central control and maintenance control
- Central control and dispatched maintenance personnel
- Dispatched maintenance personnel and maintenance control
- Dispatched maintenance personnel and other dispatched maintenance personnel

There are various means and combinations by which these links can be accommodated. They include base radio stations, mobile radio units in transit motor vehicles, "handie talkies", intercoms and an assortment of telephone communications equipment (drop lines, emergency or standard).

"Handie talkies" provide the greatest flexibility for coordination between dispatched AGT personnel. However, they may not be adequate for tunnel applications or where large structures (building, etc.) may restrict transmissions. For these applications and for larger systems, where the guideway may encompass a large area, a relay station may be necessary for adequate system wide communications. In addition to "handie talkies", maintenance motor vehicles, tugs or other rescue vehicles should be equipped with mobile radio units.

Drop line telephones requiring no dialing are recommended between central control and maintenance control in addition to 2 way radio communications.

For major or severe problem occurrences, the need to dispatch other specialists such as security, fire or medical personnel may be required. Unlike conventional transit systems, these services in AGT are normally supplied by adjacent city, county, airport or even college agencies. Central control should have direct telephone contact (preferably drop lines) to respective dispatchers at the headquarters for each outside agency that may be required. In airport applications, one drop line to the airport Department of Public Safety may be adequate since they are usually responsible for security, fire and medical assistance. It is desirable that personnel dispatched from outside agencies be equipped with "handie talkies" operating on the same frequencies used by AGT personnel. If not, on site AGT personnel possessing "handie talkies" should assist these personnel in communicating with central control as required.

2. Dispatching AGT Personnel

As stated earlier, the need to dispatch trained personnel to resolve some problems will be required. These include occurrences where there is a definite need for corrective maintenance, first aid, security, fire equipment or any potentially hazardous situations. The type of personnel dispatched will, of course, be dictated by the specific problem occurrence. Typically, the following types of services and capabilities should be available in AGT:

- Maintenance
- Security
- First Aid
- Fire
- Evacuation and Rescue
- Information.

Cost makes it impractical for AGT systems to have separate organizations for each of the above services. Frequently one AGT discipline will have to serve several functions. Typically, it is maintenance personnel who serve a multiple function in resolving most daily problem occurrences that require personnel to be dispatched. For example, AGT maintenance personnel are often trained and equipped to handle information needs, evacuation and rescue, small fires, minor security duties and sometimes even provide first aid treatment. When more specialized personnel are required for unique or major occurrences, central control will dispatch appropriate personnel as dictated by the specific problem and the severity of the problem. These specialists may include security, fire or medical personnel. In most cases, the specialists may not be AGT personnel per se, but will be personnel from local city/county agencies, adjacent airports, colleges, etc. Working agreements between AGT systems and adjacent organizations are typical for security and major fire or medical needs. This time sharing of specialized personnel, who are needed on an infrequent basis, is cost effective and in most cases adequate to handle the needs of most AGT operations. It is important that appropriate procedures be established and well understood by all local authorities whose services might be called upon to aid AGT operations. Establishing this time sharing relationship should start early in the design of the system so that maximum benefits can be obtained from the mutual operation. Design/procedural inputs from interfacing agencies should be encouraged. All interfacing agencies should be knowledgeable of key system locations/equipment; general mode of operation; system related hazards; modes of communications/radio frequencies used, etc. Formal certified training programs should be established and provided at intervals to accommodate the normal turnover rate of applicable system related personnel. Periodic mock disasters/emergencies should be staged to insure smooth and efficient response to possible emergency occurrences.

Another key consideration, related to dispatching personnel for problem occurrences, has to do with response times of dispatched personnel. Since maintenance personnel are predominately dispatched to multiple types of problem occurrences, it is important that they are utilized effectively. There are two approaches currently being used to accomplish this:

(1) Stationing maintenance personnel at maintenance control or some fixed location and dispatching them as required for problem occurrences or scheduled duties.

(2) Assigning some maintenance personnel to various segments of the system and allowing them to constantly rove their assigned area, and resolve problems as they are detected or reported.

The first approach has been used at Sea Tac and Morgantown with good success. For somewhat larger and more complex systems like AIRTRANS, the second approach has been effective. The approach used, depends primarily upon the size/complexity of the system and accessibility to the remote segments of the system. As a goal, response times to arrive at problem occurrence sites should be three minutes, or less for most cases. Arrival times greater than six to seven minutes borders on being unsatisfactory.

There are other considerations related to dispatching personnel to problem sites. These include:

o Dispatched personnel should not have to use the transit system when responding to problem occurrences. (Particularly, hazardous occurrence where passenger safety is threatened or for occurrences that might result in a substantial impact on service.) The threat of queue involvement is possible, thereby preventing dispatched personnel from reaching the problem site.

o When dispatched personnel arrive at the scene of a problem, they should immediately inform central control that they are on site of the occurrence. This relieves central control of uncertainties that may arise surrounding the problem. Reporting is extremely important for vehicles that have stopped between stations. If the dispatched personnel arrives at a stopped vehicle and enters it unannounced, central control will receive an unscheduled door opening indication. Central may interpret this as an indication that passengers are abandoning the vehicle and may remove power from the guideway unnecessarily.

3. Remote Control Features

For station equipment related problems, remote control features activated from central control can provide a fast and effective means of resolving various occurrences that might otherwise require dispatching AGT personnel. Although initial costs of such installations may be high, manning requirements are reduced and the faster response times associated with remote control features minimize impact on passenger service and enhance safety.

The following applications should be considered for station related equipment:

a. Station and Vehicle Boarding Doors* - Central control shall have the ability to "cycle" and "hold" vehicle or station boarding doors as required. These commands should be used to open or close doors when normal berthing operations have failed or when it is desirable to prevent a vehicle from departing a station because of system problems down stream.

Central control should also have the ability to modify station dwell times as required to accommodate crowds and ensure proper vehicle spacing. Some systems may dictate a need for automatic bunching control which will vary individual station dwell times as required to obtain proper vehicle distribution throughout the system. Other systems may require this to be done by central control personnel through the use of "door hold" control features.

b. Turnstiles - Central control should have the ability to "lock" or "freewheel" turnstiles. This need may be greater for systems using automatic fare collection (AFC) systems instead of coin operated turnstiles.

c. Escalators - Central control should have the ability to "stop" and "start" ** escalators. The "start" feature becomes important when emergency stop buttons are provided on the escalators. Central control should control restart operations to ensure passengers safety. The stop feature is required for occurrences of falls on escalators that are detected on CCTV.

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*Denotes a remote control feature that is a firm requirement for AGT.

**Remote starting should not be performed unless it can be verified that escalator is clear of people and safe for restart.

d. Special Access - There are situations where "special" access is required. Consider the following applications:

- Wheelchair and Employee Gates - If special gates are provided for wheelchair users and employees, central control should have the ability to control such gates.

- Restroom Access - Some systems may dictate the need for controlled access to restrooms because of crime and vandalism. Central control should have the ability to allow entry as required. (i.e., allowing one person in restroom at a time).

- Elevator Access - Elevators provided to accommodate the elderly and handicapped may require limited access. Central control should have the ability to control access to elevators as required.

4. Altering System Operations

For some problem occurrences (large crowds, abnormal weather, fires, etc.) it may be necessary to initiate commands that will alter normal system operations. Frequently these commands will impact the entire system or a significant portion of it. These may typically include:

- Speed overrides on vehicles and guideway sections during adverse weather. Reducing vehicle speeds on grades during ice, snow, and rain help to improve traction/reduce false over speed conditions caused by spinning wheels.
- Changing route codes or initiating switch overrides to avoid vehicle queues, fires, etc., and to accommodate large crowds.

- Removing power from the entire guideway or appropriate sections of the guideway with the occurrence of people or foreign objects in the guideway, during evacuation and rescue or when corrective maintenance dictates the need.

- Issuing stop commands to vehicles to avoid problem areas.

These types of commands are systems related and are typical of AGT systems. Many are not directly related to PS & CS problems, but may indirectly impact passenger safety/service. The following system command features from central control should be assessed and included as dictated by specific system applications.

Ability to:

- Reroute vehicles
- Override or award merge and diverge switches
- Remove power from the entire guideway or appropriate sections of the guideway
- Provide speed overrides on vehicles and guideway sections
- Stop and start individual vehicles
- Ability to reset vehicle malfunctions
- Initiate inhibit stops at stations

CHAPTER 7. GENERAL RECOMMENDATIONS AND CONCLUSIONS

Preparation of this guidebook indicates there are some areas of Passenger Safety and Convenience Services which still require additional study. These areas include improvements in providing routine services as well as better means of accommodating some problem occurrences. Efforts applied early in the design of new systems will be required to resolve some of these problems. For others, advances in current technologies may be required. The following problem areas were identified:

1. Detection of Foreign Objects in the Guideway

Present means of detecting foreign objects in the guideway are not adequate. The ability to detect people, animals or large objects in vehicle right-of-ways in sufficient time to avoid collisions or to initiate emergency stops will require technological advances to ensure passenger and system safety in AGT systems.

2. Lost or Confused Passengers

The occurrence of lost or confused passengers is without question the most frequently occurring, non-hazardous problem identified during preparation of this guidebook. Developing methods and procedures to accommodate the occurrence of this problem is not sufficient. The answer is one of prevention, through improved information transfer through improved graphics. Standard guidelines or specifications are needed for the system designer to ensure more effective and standardized information systems in AGT.

3. Inoperative Equipment

Reliability problems associated with Automatic Face Collection (AFC) systems have been prevalent and often result in high workload demands on central control and maintenance personnel. Means of detecting and responding to AFC problem occurrences are adequate but time consuming. To reduce these workload demands, improved reliability of AFC equipment is needed.

4. Elderly and Handicapped (E&H)

Accommodating the E & H in AGT systems presents double challenge for the system designer. The first, is to provide a barrier free system for the E & H during normal routine operations. The second and more challenging problem, deals with accommodating the E & H during emergencies. Even the most modern transit systems which are barrier free during normal operations have obstacles which are not negotiable by a large portion of the E&H population during emergencies unless assistance is provided. The technology exists to overcome these barriers, but the cost of providing for such infrequent occurrences is very high.

5. Improved Visual Information for Central Control Personnel

Central control personnel in many situations feel the need for more visual information. With additional CCTV coverage or visual access to problem areas, certain problems could be prevented or resolved more rapidly and with greater assurance. Of course, cost makes it impractical to provide CCTV coverage of an entire system, however, there are some alternatives. For relatively small systems and where the surrounding terrain allows, consider the following:

- One or two CCTV cameras mounted on elevated structures that would enable visual access to a large portion of the system. Pan, zoom, stop and start control features would be required.
- Elevate the central control room and provide windows to allow visual scanning of the system similar to control towers at airports.

Both of the above have limitations but could provide central control personnel with additional information that would enhance their decision making process during problem occurrences.

6. PS & CS Record Keeping Policy

It has been discovered during the preparation of this guidebook that many PS & CS problems are not receiving adequate consideration in current transit operations. Frequently transit personnel are most concerned with "keeping the system going" and consequently many passengers needs are being overlooked. Systems related problems are typically documented in daily logs at central control but seldom do these address specific passenger problem occurrences. Many transit systems have real time recorders which record all voice communications to and from Central Control. More often than not, the recorded information is not systematically reviewed and tabulated in a usable form. The result is that operational personnel at the same site frequently have quite different opinions on what the major passenger problems are for that system. To correct this, it is recommended that the new AGT operations establish a simple buy systematic method of recording occurrences of PS & CS problems. This daily log should be the responsibility of central control personnel and as a minimum should contain the following:

- type of passenger problem occurrence
- time of occurrence
- occurrence site
- detection/reporting method
- response method
- time when problem was resolved/comments.

The intent of such a record is to provide a quantitative means of determining major or repetitive passenger problems and identifying areas where improvements may be required. In some cases, only operational changes may be necessary, while others may require design modifications.

APPENDIX A

GLOSSARY

Automated Guideway Transit (AGT)

The current dominant means of public transportation are the transit bus and rapid rail systems. The development of computer and automation technology, particularly in the last decade, has led to the formulation of new public transportation concepts which use vehicles capable of automatic operation on separate roadways or guideways. Such systems are generally called Automated Guideway Transit (AGT).

Group Rapid Transit (GRT)

Group Rapid Transit Systems (GRT) utilize automated vehicles on more extensive networks than SLT systems. They tend to have shorter headways than SLT systems, use switching and may or may not employ off-line stations. Vehicles with a capacity of 10 to 70 passengers, operating singly or in trains with headways of 3 to 90 seconds, characterize such systems. State-of-the-Art GRT Systems (e.g., Airtrans, Morgantown) operate at headways 15 seconds or greater.

Personal Rapid Transit (PRT)

Personal Rapid Transit Systems (PRT) are usually system concepts characterized by small vehicles (2-9 passengers) carrying parties travelling together by choice. Such systems generally feature off-line stations and an extensive guideway network. Most proposed systems call for vehicles to be operated at headways of three seconds or less.

Shuttle-Loop Transit (SLT)

Shuttle-Loop Transit Systems (SLT) are the simplest type of Automated Guideway Transit Systems and are characterized by vehicles moving along short linear segments or loops with few or no switches. The vehicles may operate singly or trained. Bypasses may be permitted in the shuttle to permit intermediate stations.

APPENDIX B

ABBREVIATIONS/ACRONYMS

AFC	Automatic Fare Collection
AGT	Automated Guideway Transit
ATC	Automatic Train Control
BART	San Francisco Bay Area Rapid Transit
CCTV	Closed Circuit Television
E&H	Elderly and Handicapped
GRT	Group Rapid Transit
MPM	Morgantown People Mover
MUNI	San Francisco Municipal Railroad
NYCTA	New York City Transit Authority
PA	Public Address
PATCO	Port Authority Transit Corporation, N. J.
PATH	Port Authority of New York and New Jersey Trans Hudson
PRT	Personal Rapid Transit
SEA TAC	Seattle-Tacoma Airport Satellite Transit System
SLT	Shuttle-Loop Transit
TTC	Toronto Transit Commission
WMATA	Washington Metropolitan Area Transit Authority

APPENDIX C

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APPENDIX D

REPORT OF NEW TECHNOLOGY

While leading to no new technology, the work performed under this contract has evaluated current practices in providing transit passengers with safety and convenience services in relation to the special requirements of AGT systems. Guidelines have been developed for providing safety and convenience services to AGT systems' passengers. Several new concepts are introduced which apply existing technology to new problems.

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